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THE SHOCK AND VIBRATION DIGEST

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SVIC NOTES

I hope our readers were not inconvenienced greatly by the lateness of the May, June, and July issues of **The Shock and Vibration Digest.** Printing was unavoidably delayed due to a major change in the way the printing contracts for the **Digest** are handled. This is a transient phenomenon which, hopefully, will not be repeated.

I sincerely regret these delays and I am making every effort to insure that there are no more delays in the future.

J.G.S.

EDITORS RATTLE SPACE

54th SHOCK AND VIBRATION SYMPOSIUM -- MORE THAN A MEETING

This issue of the DIGEST contains the preliminary program for the 54th Shock and Vibration Symposium. It will be held at the Huntington Sheraton Hotel in Pasadena, California on October 18-20. The Jet Propulsion Laboratory will be the host serving on behalf of the National Aeronautics and Space Administration. Dr. Showalter and the program committee have scheduled an interesting and informative program. Of particular interest are the three plenary speakers -- Mr. Strether Smith of Lockheed Palo Alto Research Laboratory who will talk on modal testing, Dr. George Morosow of Martin Marietta Corporation who will give a method for solutions to structural dynamics problems and Dr. Wilfed Baker of Southwest Research Institute who will talk about blast and ground shock. Since their inception at the 50th Symposium by Mr. Henry Pusey the Plenary talks have been a highlight of the Symposium.

It is interesting to reflect on the question of why engineers attend the Symposium. After all one can purchase the bulletin and read the papers at your leisure. But will the average person read the bulletin after the fact unless there is an immediate problem? I doubt it. Attendance at a meeting like the Symposium is a forced change of pace from our daily hectic schedule. It provides time to reflect, refresh, redirect, and reenergize. Listening to the presentations and discussions while not under pressure enhances the formulation of ideas for use or adaptation to immediate and long range needs. The informal conversation before, between, and after sessions provides an opportunity to exchange ideas, do business, and learn about new products.

Thus the Symposium is more than a collection of papers being read to an interested group of engineers. It is a forum for the exchange of technical information built around a formal technical program. It is collection of people with similar interests and goals -- to design, develop, and operate quality trouble-free equipment. I hope you will provide time in your schedule to participate in this rewarding experience.

R.L.E.

SQUEEZE-FILM DAMPING OF ROTOR-DYNAMIC SYSTEMS

M. Dogan* and R. Holmes*

Abstract. ***This article is a review of the roles of the squeeze-film damper when used in parallel with a flexible element in a vibration isolator and when used in a series with flexible pedestals or the frame of a rotor-dynamic system [1].***

An early demonstration of the squeeze film in practice was made by Cooper [2], who was given a patent for the design of squeeze-film bearings. He examined the vibration effects of an unbalanced stiff shaft running in elastically supported bearings. The limitation of orbit using mechanical stops caused heavy pounding of the limiting stops and instability of the shaft motion. Control of the orbit by the squeeze-film effect was obtained from experiments and theoretical considerations based on the short-bearing solution of the Reynolds equation. In this solution the whirl orbit was assumed to be circular and centered in the bearing. Cooper showed that squeeze films can be designed successfully to attenuate rotor vibration amplitudes.

In 1967 a device was described for the control of critical speeds [3]. The device consisted basically of a squeeze film between two nonrotating parts in parallel with a flexible bearing support. A mathematical model of the vibratory system assumed linear damping. The damping constants were evaluated experimentally for given system parameters. Tests were performed both with and without oil; results indicated significant increase in damping of the total system with the film. Oil flow rate was also varied; an increase in damping with high oil flow was observed. It was concluded that the experimental rig proved the model qualitatively.

White [4] studied the dynamics of a vertical rigid rotor supported on squeeze-film bearings, extending the analysis of Cooper. White used the short-bearing approximation and finite bearing solution in a study of the stability of three predicted bearing-center orbits. He showed numerically that the intermediate eccentricity orbit was always unstable and that the others were stable, assuming a linearized model for the film behavior with reference to an equilibrium orbit. These results were also demonstrated experimentally; jumps from one orbit to the other were observed. For low L/R (0.735 and 0.338) ratios the agreement between predicted and experimental jump speeds was good; for larger ratios the agreement was poor. It was suggested that the film model was in error for large L/R ratios due to the persistence of cavitation bubbles as the load-carrying region passed through.

Holmes [5] showed, from the theoretical solution of the nonlinear equations of motion of a rigid rotor supported on squeeze-film bearings, that load carrying capacity could be obtained without the use of additional support stiffness. He found that the value of the bearing parameter β plays an important role in squeeze-film performance.

$$\beta = \eta R(L/C)^3/m\omega$$

in which η is viscosity; R, L, and C are the squeeze-film radius, length, and radial clearance; m is the rotor mass; and ω the rotor speed.

Jones [6] investigated squeeze-film hydrodynamics experimentally. The objective of his experimental work was to establish a suitable theoretical basis for design purposes. He found that the so-called infinitely short film theory provides a reasonably good approximation to squeeze-film behavior for eccentricity ratios up to about 0.8 for the case of circular concentric orbits with small values of radial clearance.

Thomsen and Anderson [7] reported an experimental investigation of a squeeze-film damper for the control of rotor amplitudes. The range of damping available

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from the squeeze-film damper was investigated by varying radial clearance and oil viscosity, with a limited amplitude of vibration up to a maximum of 25 percent of the radial clearance. The damping coefficient was obtained by measuring the transmitted force and the velocity of the damper sleeve. A formula was given for the damping coefficient assuming the short-bearing full-film model; it was concluded that the agreement between theory and experiment was acceptable.

Mohen and Hahn [8] presented a theoretical study of design data for squeeze-film bearings supporting a centrally preloaded rigid rotor mounted in antifriction bearings. For theoretical analysis the short-bearing approximation was used. It was shown that a third stable but noncircular mode of operation was possible for a sufficiently low value of bearing parameter β (e.g., 2×10^{-2}). This was also an undesirable mode of operation because the transmissibility and the journal excursions were large.

Vance and Kirton [9] carried out an experimental study of the hydrodynamic force response of a squeeze-film damper with end seals. The experimentally determined pressure distributions were numerically integrated to obtain the force components of the squeeze film. The results were compared to long-bearing and short-bearing solutions of the Reynolds equation. For the centered orbit case the long-bearing theory was reasonably accurate in predicting the shape of the pressure distribution. However, the peak-to-peak magnitude of the pressure distribution was not accurately predicted by this theory.

Theoretical data were used for a single-mass rotor to determine the damping and stiffness of a squeeze-film damper. The damper was used to attenuate rotor amplitudes and bearing loads for a multi-mass rotor operating through and above its first bending critical speed. An equivalent single mass for the multi-mass rotor was calculated from the first critical speed of the rotor and its shaft stiffness. A squeeze-film damper was then designed to provide the required damping based on the short-bearing half-film model with the assumption of circular orbits. Analytical rotor response results showed that the squeeze-film damper successfully attenuated rotor amplitudes and bearing loads. Mid-span rotor amplitude was reduced by a factor of 16, and bearing load was reduced by a factor of 36 compared with the same rotor on rigid bearing supports.

Botman [11] carried out experimental work on a squeeze-film damper rig designed to evaluate the effect of damper geometry on rotor responses. A vertical arrangement was chosen in order to avoid the continuous presence of the gravity load on the oil film. An additional support stiffness was also introduced. For synchronous behavior excitation was generated by unbalances on the rotor. The rotor was capable of stable running up to a speed of 60,000 rev/min. Various damper geometries differing in length, clearance, and surface finish were tested. Test results were in agreement with existing theoretical predictions below the speed at which cavitation began. At high speeds the damper generated nonsynchronous motion.

Simandiri and Hahn [12] investigated theoretically the effect of pressurization on the vibration isolation capability of centrally preloaded squeeze-film bearings supporting a rigid rotor in rolling element bearings. The short-bearing approximation was used; steady-state synchronous circular orbits about the bearing center were assumed. The journal orbit eccentricity ratios and transmissibilities were very much dependent on the bearing parameter $\eta R L^3 / m\omega c^3$, supply pressure, and unbalance. It was also suggested that the rotor/bearing system can be controlled to run at minimum vibration level or with minimum unbalance transmissibility by varying the supply pressure.

Tonnesen [13] presented the results of an experimental investigation in which the damping coefficients of a squeeze-film bearing were obtained from impedance measurements. Tests were performed for both concentric and eccentric cases, varying unbalance, bearing length, radial clearance, and oil viscosity. For the concentric case, test results correlated well with the short-bearing half-film model for orbit amplitudes up to 50 percent of the clearance. For the eccentric case, however, the limits were much smaller.

The effect of squeeze-film damper bearings on the steady-state and transient unbalance response of aircraft engine rotors was examined [14]. A nonlinear transient analysis assumed circular synchronous motion; the purpose of the analysis was to investi-

gate the dynamic behavior of the squeeze-film damper under rotating unbalance and with or without the effects of a retainer spring. The analysis showed that excessive stiffness in the damper resulted in large journal amplitudes and transmission of bearing forces to the engine casing. The effect of pressurization caused reduction of the effective squeeze-film stiffness and an increase in its effective damping. It was concluded that time-transient analyses of squeeze-film bearings are necessary in damper design because circular synchronous precession of the journal about the bearing center is not always achieved, and the linearized stiffness and damping coefficients no longer provide a valid description of the squeeze-film behavior.

The squeeze-film forces produced by circular centered orbits was investigated both experimentally and analytically [15]. The damper journal was constrained to move in predetermined circular centered orbits in a specially designed, end sealed, test rig. The force components were determined numerically by integrating the measured pressure profiles. The results showed that the long-bearing theory was reasonably accurate in predicting the shape and the magnitude of the pressure distribution. However, for the cavitated film the damper forces were critically dependent on the effects of inlet and cavitation pressures. In a later paper Bansal and Hibner [16] extended the same investigation to the case of offset circular orbits. They found that the measured values were significantly different from predicted values.

Holmes [17] analyzed the damping characteristics of a squeeze-film damper with a linear retainer spring. The short-bearing uncavitated film force expressions were linearized assuming small oscillations of the journal center about the static equilibrium position. Analyses were made only for resonance conditions; two damping coefficients were produced. It was shown that an estimate could be made of the range of validity of the appropriate linear damping coefficients. The nonlinearities were also simplified by deducing effective amplitude-dependent quasi-linear damping coefficients.

Robinowitz and Hahn [18] investigated theoretically the stability of the steady-state synchronous operation of centrally preloaded single-mass rigid and flexible rotors supported in squeeze-film dampers. Short-bearing approximation and symmetric motion were assumed; the stability analysis was made for small perturbations about the equilibrium state with linearized film forces. The results showed that stability regions for rigid rotors with the bearing parameter $\eta R L^3/m\omega c^3$ = 0.2, 0.6, 1.2, and 2.0 were found for eccentricity ratios below 0.6 when unbalance parameters u/c were 0.05, 0.2, and 0.4. It was indicated that bistable operation occurred and that the intermediate eccentricity orbit was always unstable; the higher and lower eccentricity orbits were always stable. For flexible rotors a high unbalance parameter and a low bearing parameter increased the likelihood of instability.

Marmol and Vance [19] developed a mathematical model for predicting the effects of seal leakage and inlet pressure on the performance of squeeze-film dampers. Piston ring and O-ring type end seals were modeled to create continuity of flow throughout the damper; the resulting equations were written in finite difference form. The total pressure distribution was solved simultaneously using a banded matrix inversion technique. The test data were taken from a high-speed free-rotor test rig [11] and three other low-speed controlled orbit rigs [15]. The results of the computer solution were in close agreement with experimental data taken from the three controlled-orbit rigs and were in fair agreement with data taken from the high-speed free-rotor rig. It was concluded that the long-bearing model was a good approximation for calculating damper pressures for small amounts of oil leakage. However, for considerable leakage the short-bearing model was a closer approximation.

Humes [20] studied theoretically and experimentally the performance of a squeeze-film bearing when used without the assistance of retainer springs. The experimental rig used was required to simulate a small gas turbine rotor supported at each end on squeeze-film bearings. Unbalance masses were applied symmetrically to the rotor, and the associated orbital motions of the rotor were recorded for various combinations of rotor speed (up to 4000 rev/min), squeeze-film clearance, land width, and viscosity. The short-bearing solution of the Reynolds equation was assumed. Two theoretical models -- the cavitated film model and the so-called maximum pressure film model with varying degrees of cavitation and supply pressure -- were developed from experimental pressure measurements. Theoretical and experimental results

showed reasonable agreement for the case of the cavitated film model with cavitation at a negative pressure between −15 and −20 psi gauge pressure. However, in some cases the minimum film thickness was overestimated by this model. The maximum pressure film model showed closer agreement with the experimental orbits with respect to minimum film thickness. Sustained lift of the rotor was obtained by assuming a cavitated film model. The experimental pressure measurements indicated that cavitation was occurring and that the cavitation pressure was remarkably low (−20 psig). These results suggested that the squeeze film could temporarily support tension.

Humes and Holmes [21] developed a mathematical model of the squeeze film based on experimental information that showed the ability of the squeeze film to sustain appreciable subatmospheric pressure. The squeeze-film forces P_1 radially and P_2 tangentially were written as

$$P_1 = P_{1\pi} + b\,(P_{1F} - P_{1\pi})$$

$$P_2 = P_{2\pi} + b\,(P_{2F} - P_{2\pi})$$

$P_{1\pi}$ and $P_{2\pi}$ are the squeeze-film forces arising from a π film, and P_{1F} and P_{2F} are those arising from a full 2π film. The factor b allows the generation of a certain amount of subatmospheric pressure. A comparison of predicted and experimental vibration orbits taken from the test rig [20] showed that the mathematical model for a certain value of the b factor gave reliable predictions of vibration orbits. However, no general value for the factor b is representative over a wide range of operation parameters.

Kuroda and Hori [22] reported an experimental study on the cavitation phenomenon and tensile stress in a squeeze film. They used two parallel circular plates separated by a thin viscous fluid film. One of the plates was kept at rest; the other was oscillated in a direction normal to its surface. Tensile stress occurred in the range of negative squeeze action. When the squeeze motion changed from positive to negative, the induced pressure also changed sign. The negative pressure grew in absolute value to vacuum pressure and then exceeded vacuum pressure. The fluid was in a state in which tensile stress at every measurement point for a period of 0.29 sec differed in intensity and duration. A maximum tensile stress of −49.77 psig was recorded at a measurement point close to the center of the plate.

Pan and Tonnesen [23] examined the eccentric operation of a squeeze-film damper under gravity and unbalance loads. The short-bearing approximation and circular orbit motion of the damper were assumed. The squeeze-film forces were normalized by using a Fourier expansion; both synchronous and nonsynchronous cases were considered. A static lift force calculated when the half-film model was imposed opposed the displacement of the orbit center. No such lift was calculated with the full-film assumption.

Theoretical and experimental investigations were carried out on squeeze-film dampers with end seals [24]. A circular centralized orbit of the damper journal was assumed; the finite element method was applied to calculate pressure distribution in the damper. O-ring and piston ring seals were tested. Theoretical results agreed only qualitatively with experimental results. It was presumed that boundary conditions at the boundaries of the oil film (oil film and oil groove, oil film and inlet hole) were not so simple as the theoretical assumptions required.

Cookson and Kossa [25] reported a study on the effectiveness of squeeze-film damper bearings without a centralizing spring. Both a rigid rotor and a flexible rotor symmetrically loaded and supported by squeeze-film damper bearings were investigated. The short-bearing approximation with the half-film model was employed; different unbalance, weight, and bearing parameters were used. For the rigid rotor case the most effective squeeze-film damping was produced when the bearing parameter β was approximately equal to 0.1 and the weight parameter was lower than 0.1. For high values of the bearing parameter (0.5 to 1.0) the damper was not beneficial; instability resulted for a very small value of bearing parameter (0.00002). For the flexible rotor case the damper was most effective when the weight parameter was small (0.04) and the bearing parameter was between 0.05 and 0.5. However, the analysis was restricted to the case in which the unbalance parameter u/c was 0.1.

Parkins and Stanley [26] presented a theoretical and experimental investigation into the behavior of an oil film contained within two plane surfaces having

only normal oscillatory relative motion. Tests were performed for a range of frequency, amplitude, and mean film thickness. A steady-state oil film force was identified in addition to the dynamic force. This steady force was dependent on the amplitude of the oscillatory motion, its frequency, and mean oil-film thickness. Subatmospheric and sub-zero oil film pressures were recorded to a maximum peak value of −17.95 psig for a duration of 0.009 sec. The existence of sub-zero oil-film pressures implied that an oil film could support tensile stresses as reported by other workers. A finite difference treatment was used for the theoretical oil pressure field; pressures were integrated over the field. Simpsons rule was used to obtain the oil-film force. Theory agreed reasonably with practice but overestimated some oil-film pressures and film forces in both positive and negative squeeze actions. It was suggested that the theory required extension to include the effects of alternative boundary conditions and fluid inertia.

Dede [27], in a theoretical and experimental study, investigated the nonlinear performance of a squeeze-film damper with a parallel stiffness. The stiffness was provided by a beam on which the journal was mounted; the damper had no end seals. Excitation of the damper journal was by means of electromagnetic vibrators in vertical and horizontal directions. The short-bearing solution of the Reynolds equation was used to obtain the hydrodynamic pressure in the damper; the pressure so obtained was then modified by curtailing the negative pressure to a value determined experimentally. From the experimental pressure recording it was shown that the negative pressure limit could be prescribed as −15 psig to give good prediction of vibration orbits. The experimental positive pressure recordings were lower than the predicted ones. It was noted, however, that the positive pressure limitation was not very effective on orbit size and disposition. A determination of the linear damping coefficients proved to be adequate when linear conditions were met and when the negative pressure was curtailed at −15 psig. It was concluded that the negative squeeze-film pressures were very effective on damper performance and should therefore be taken into consideration at the design stage.

Although a large amount of work has been done on the performance of squeeze-film dampers, most of the work has been concerned with squeeze-film behavior for synchronous and/or centered motion. The performance of the squeeze film without support stiffness has not been investigated sufficiently with respect to actual engine operating parameters.

The objective of any new work should be to investigate the performance of a squeeze film as a load-carrying member as well as its damping, extending the work of Humes [20]. The operation of the squeeze film when used in series with flexible support structures should also be considered. The squeeze film should be represented in terms of quasi-linear damping and stiffness coefficients, so that standard linear programs can be used to analyze the performance of multi-degree-of-freedom rotor/bearing systems.

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LITERATURE REVIEW: survey and analysis of the Shock and Vibration literature

The monthly Literature Review, a subjective critique and summary of the literature, consists of two to four review articles each month, 3,000 to 4,000 words in length. The purpose of this section is to present a "digest" of literature over a period of three years. Planned by the Technical Editor, this section provides the DIGEST reader with up-to-date insights into current technology in more than 150 topic areas. Review articles include technical information from articles, reports, and unpublished proceedings. Each article also contains a minor tutorial of the technical area under discussion, a survey and evaluation of the new literature, and recommendations. Review articles are written by experts in the shock anr [illegible] ration field.

This issue of the DIGEST contains an article about leakage flow-induced [illegible] ations of reactor components.

Dr. Thomas Mulcahy of Argonne National Laboratory, Argonne, Illinois h [illegible] ten a paper that reviews leakage flow problems for the purpose of identifying design features and excitation sources that should be avoided.

LEAKAGE FLOW-INDUCED VIBRATIONS OF REACTOR COMPONENTS

T.M. Mulcahy*

***Abstract.** Secondary flows through narrow gaps in reactor component supports, which are much smaller than but parallel to the primary coolant flow, occasionally are the excitation source for significant flow-induced vibrations. These so-called leakage flow problems are reviewed in this article for the purpose of identifying design features and excitation sources that should be avoided.*

Rod, tube, plate, and shell components in nuclear reactors are exposed, from start-up through steady-state operation, to a wide range of coolant (heat-transfer fluid), cross or parallel flow velocities, and temperatures. Not uncommonly the components are a channel for the flow. Thus, the components must be provided sufficient lateral support to maintain acceptable bending vibration levels and, at the same time, allow axial movement to accommodate thermal expansion, control movements, and removal. Lateral support is usually provided by the wall of a slightly larger hole in a plate, the inside of another tube -- (a) of the Figure -- or shell, or a channel -- (b) and (c) of the Figure -- that have similar but slightly larger cross sectional shapes.

More likely than not the main coolant flow establishes a pressure drop across the plate, cylinder, or channel in which the lateral support is located, and fluid leaks through the narrow passages created to allow axial motion of the component. Thus, a support that would have limited lateral vibrations for a still fluid [1] can be the site of flow-induced vibration (FIV) sources called, appropriately, leakage-flow excitation mechanisms. In this article a general characterization of the fluid forces and vibration excitation mechanisms is given before a component-by-component enumeration of the problems and mechanisms is made.

FLUID FORCES AND EXCITATION

FIV mechanisms formed by narrow leakage flow passages are very complex. Simplifications and definitions are necessary in a discussion of the mechanisms. In the past excitation mechanisms have been categorized [6] by associating them with two extreme types of fluid forces: fluid-excitation forces, which would exist independent of structural motion, and fluid-structure coupling forces, which cannot occur without structural motion. Structural vibrations caused solely by fluid-excitation forces are often called forced vibrations; vibrations associated with fluid-structure coupling forces are often called self-excited vibrations

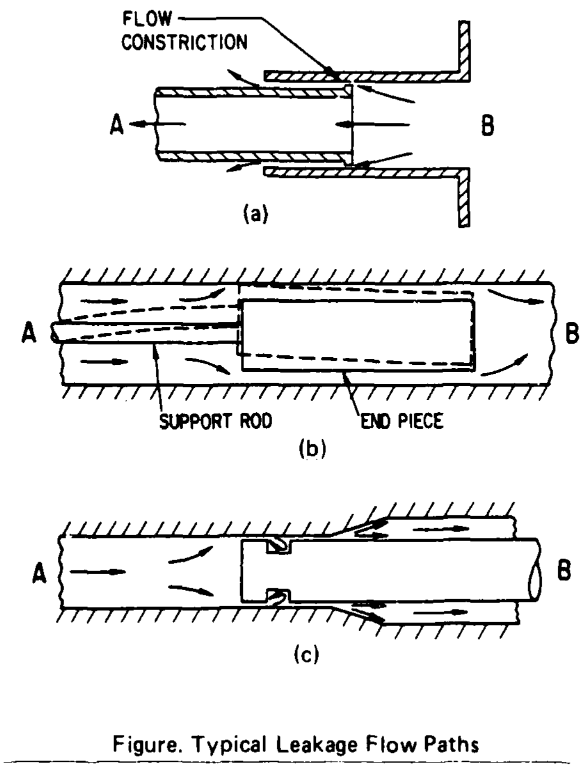

Figure. Typical Leakage Flow Paths

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Excitation of rods, plates, and shells due to the pressure fluctuations of an attached turbulent boundary leads to relatively small motion for isolated bodies [9]. The extreme confinement of narrow passages can be expected to produce even greater fluid damping for dense fluids. Thus, significant fluid excitation forces are not expected as a result of an attached boundary layer flow. Much stronger fluid-excitation forces exist for separated flows, partly because energy is concentrated in narrow frequency bands. In practice, the narrow passages are of finite length; geometric discontinuities usually occur at the entrance, at the exit, or at intermediate cavities. The bluff leading and trailing edges of the bodies forming entrances and exits in (b) and (c) of the Figure, the diffuser exit in (c), and the cavities in (c) are sites at which flow separation can occur. Moreover, examples are known [2, 4, 8, 10, 12, 19-21] in which significant fluid-excitation forces are created by detached boundary layer flows.

Acoustic energy or pump pulsations are other sources of significant energy that is concentrated at discrete frequencies that usually are known or readily determined. If their strength and distribution are also known, vibrations can be predicted. Most often, resonant vibrations are avoided by making sure the source and structural natural frequencies are not close to coincidence.

Self-excitation mechanisms appear to be more prevalent than fluid-excitation mechanisms in narrow passages, at least for dense fluids. The fluid damping mechanism of narrow channels, which can be an effective attenuator of forced excitation, is probably modified in a self-excitation mechanism. In fact, in many situations self-excitation can be said to occur when the negative fluid damping created exceeds the positive structural damping. The major design problem is to identify the conditions that produce self-excitation.

Self-excitation occurs when, during a complete cycle of vibration, the energy input to the structure by the fluid exceeds that which can be dissipated. This conceptually simple statement of the conditions necessary for instability is difficult to verify in general because the motion of the structure and the fluid forces are nonlinear functions of each other and the flow velocity field. Fortunately, only an instability is usually of interest, and infinitesimal periodic motions can be assumed. This greatly simplifies the analysis [6, 7, 9] for conditions of static divergence, in which displacements increase monotonically at a zero frequency and dynamic instabilities, in which the oscillations become unbounded with time.

PLATES AND BLADES

The forced-excitation of plates and blades in narrow channels does not appear to be a strong excitation mechanism because no specific problems have been reported in the literature.

Early interest in the self-excitation of rods and blades in nuclear reactors was stimulated by the concern for vibration of control rods. A typical control rod geometry is well represented by (b) in the Figure if it is rotated into a vertical position with the end piece down. In the case of the control rod, the end piece is massive and rigid in comparison to the very flexible support rod.

To determine geometries that would produce static divergence (negative fluid-stiffness forces) a steady, two-dimensional (assuming a wide blade) viscous flow analysis was performed [13]. The inlet pressures and the outlet pressures for both leakage flow channels along the side of the end piece were assumed to be the same, and no entrance or exit losses were included. When the sides of the blade were parallel to the sides of the flow channel, the resultant fluid force due to both leakage flow channels was zero for any location in the channel. However, if the end piece rotated (see dashed lines in (b) of the Figure), the expanding leakage flow channel on one side of the blade produced a negative fluid stiffness force larger than the positive stiffness force produced in the converging leakage flow channel on the other side of the blade. This imbalance resulted in a static divergence.

A dynamic instability was postulated and demonstrated [14a] for the diverging leakage flow geometry (see (a) of the Figure). However, initiation of the instability was not based on static fluid forces and angular motion alterations produced by impacts with the flow channel walls as has been hypothesized [13]; rather, the mechanism was based on local fluid acceleration effects.

Consider giving the center body of (a) in the Figure an upward transitional velocity that decreases the

flow rate in the upper channel and increases the flow rate in the lower channel. As a result of these localized valving effects, fluid in the upper channel must decelerate and fluid in the lower channel must accelerate. The pressure in the upper channel must instantaneously become smaller than at A, therefore, while the pressure in the lower channel must become greater. The resultant force on the central body is thus in phase with its velocity (negative damping), and the single-degree-of-freedom system is unstable. However, if the end seals were switched to the end of the outer body (the upstream end of the leakage flow channel), positive damping would be produced and the potential for a dynamic instability would not exist.

Several quantitative analysis methods have been offered to identify when static divergence, dynamic instability, or stability would occur for more complicated examples. The failure of a fuel plate in a nuclear rocket led to two analyses and one experimental study [15, 16] of a very thin plate, with a rounded leading and streamlined trailing edge; the width of the channel and therefore the leakage flow gap could be varied. The plate was supported at its leading edge such that it could translate and rotate like the end piece in (b) of the Figure. In a flutter analysis [15] the fluid forces were obtained with a two-dimensional, inviscid potential flow theory developed specifically for model aircraft wings when wind tunnel wall interference effects are significant. In a subsequent analysis [16] the fluid forces were obtained using one-dimensional channel flow analysis methods; the object was to determine whether the inclusion of first-order viscous effects could explain the poor correlation of the potential flow based theory with the experimental results. Although both analysis methods [15, 16] were able to correlate reasonably well with the experimental data at large leakage flow channel gap sizes, neither predicted, even qualitatively, a rise in critical velocity with a decreasing gap size. The poor correlation was thought to be due to the neglect of second-order viscous effects brought about by linearization of the equations of motion.

A one-dimensional, viscous flow analysis was employed in a linearized stability analysis of a blade in a scabbard geometry [14b] with features similar to the geometry of (a) in the Figure. Instabilities were determined to exist for both a rigid body translation or rotation mode. The qualitative trends are similar to those discussed above and have been adequately reviewed elsewhere [18]. Although the qualitative behavior was predictable, the quantitative predictions of critical flow velocities and vibration frequencies were off by at least an order of magnitude. The discrepancies were attributed to the experimental difficulty of eliminating cross flow between the upper and lower channel at the sides of the blade.

RODS AND TUBES

Many forced-excitation mechanisms have been identified for a rod or a tube in a circular channel because of the prevalence of this geometry in the fuel channels of the UK Advanced Gas Cooled Reactors (AGR); long, slender, often articulated, fuel stringers are loaded into fuel channels while the reactors are generating power. As the stringer is lowered into the channel, the many different entrance and exit conditions that are created cause the gas flows to separate. Several conditions have been found to excite the fuel stringer into vibration. That all these forced-excitation mechanisms occur in gas flow could be significant. Similar and larger fluid-excitation forces can be expected for dense fluids, such as water or sodium, but squeeze-film damping will also be significant and perhaps dominant. Because refueling during operation is a major advantage of the AGR reactor, considerable research has been done and reviewed [19-21].

Structural motion was found to be important in the self-excitation of an AGR flow control device called a gag bomb. Details of fluid flow and structural response were determined in an extensive research effort [22]. Because fluid stiffness, fluid inertia, fluid damping, and flow separation were all found to be important in determining fluid-structure coupling forces, the problem is discussed in some detail below even though the device was not a true rod or tube.

The diffuser section geometry of (c) of the Figure is representative of the local flow geometry close to two of the four equally-spaced, narrow-guide fins; they protrude slightly at the major diameter of the axisymmetric main body (dashed lines) of the flow control gag bomb. The gag bomg was hung vertically, much like a pendulum, and the fluid flow provided

the only stiffness; this stiffness was substantial at normal operating gas flow rates (< 200 ft/sec). At least two self-excitation mechanisms were associated with the secondary flow in and around the smallest gaps -- the throat at the upstream end of the diffuser section -- between the narrow fins and the flow channel walls. These mechanisms were also possibly active in the much larger primary flow channel between the main gag body and the flow channel wall.

One mechanism was the flow acceleration and deceleration (local valving) mechanism [13] already described under PLATES AND BLADES. The other self-excitation mechanism identified for the gag bomb was associated with localized choking of the flow; this choking could occur on the fins but not on the main body of the gag bomb. At the instant one fin touched the side of the flow channel, the flow velocity would go to zero and flow separation would occur. A finite time was required to reaccelerate the fluid to the velocity necessary for reattachment. Thus, the fluid forces had a component in phase with the fluid velocity. Although the width of the fins was narrow in comparison to the circumference of the main body of the gag bomb at the diffuser section throat, the negative damping was evidently large enough to produce a dynamic instability.

Although the gag bomb is not a true rod in an annular region, the results described above suggest that many of the mechanisms and design rules identified for plates in channel flow are possibly applicable to annulus flows. Indeed, this trend was shown to be the case in a recent study [25] of a narrow annulus formed by a finite length rod located concentrically in a slightly larger, rigid channel. As might be expected, the existence of a fluid force in phase with the rod velocity -- a necessary condition for self-excitation -- was very dependent on upstream and downstream fluid boundary conditions.

For a finite length rod with a front end streamlined to provide a lossless entrance to the annular region (e.g., a bullet) and a free discharge at the annulus exit into a constant pressure plenum, no instability existed; the reason is that fluid damping and stiffness were positive and increased with flow. For a rod with a constriction at the entrance to the annular region and free discharge at the exit to the annulus ((a) of the Figure) -- as for the blade and gag bomb examples discussed previously -- negative damping and dynamic instabilities were possible. For a rod with a streamlined (loss-less) inlet and a constriction at the exit to the annular region, positive damping was always predicted. For a rod with a streamlined entrance and annular diffuser exit to the annulus, negative damping was not predicted unless the efficiency of the diffuser was assumed to increase as the throat size enlarged due to structural motion. The separation that occurred for the diffuser section of the gag bomb is an example of such efficiency changes.

The analysis results recited above for the annular region reinforce the applicability of all of the qualitative trends observed for blades and the gag bomb. However, experimental results and additional numerical results for more complicated geometries from the same study [25] make clear that the available information on self-excitation due to leakage flow might have a limited range of application. In particular, the instability to correlate theory with experimental results was traced to an inability to align concentrically the rod in the channel. The lateral and rotational eccentricities that are inevitable for such small gap sizes significantly influenced the results. Experiments showed that the rod with a streamlined entrance and free discharge exit to the annulus was unstable for some conditions of eccentricity. In addition, the effects of wall friction losses were included in a numerical study that showed an increase in fluid damping in many cases but a decrease in others. Further, numerical studies of a rod that could rotate as well as translate, or deform as a cantilever beam, showed that axial mode shapes were an important parameter. The same geometric configuration could be stable in one mode but unstable in another. A rod with a streamlined upstream entrance and constricted exit to the annulus is stable for rigid body lateral translations but could become unstable if a displacement node lies close to the constriction.

Other examples indicate the need for a detailed knowledge of fluid-structure interaction and a cautious application of past experience to a new design. The self-excited vibrations of a feedwater sparger [23] were attributed to leakage flow in a true annulus having features similar to (a) in the Figure. In this case, the center tube represents the third leg (thermal sleeve) of a tee forming the inlet to the feedwater sparger: a semicircular, perforated pipe with the tee

located at midlength and supports located at the two closed ends. The outside tube in (a) represents a penetration nozzle in the side of the reactor vessel. Unstable lateral (out-of-plane) vibrations of the semicircular sparger occurred. The structural motion did not occur at the measured fundamental structural frequency, but at sub- and super-harmonics of a lower key frequency that varied with flow velocity. Such motion is characteristic of a nonlinear system.

Another nonlinearity indicator was that slight perturbations in motion could cause the sparger to become unstable at flow rates for which the motion would have otherwise remained stable. All these features suggested that the previously discussed local flow valving mechanisms [13, 22] associated with lateral translations of the thermal sleeve could have been responsible for the self-excitation. However, the existence of valving was refuted by dynamic pressure transducer signals measured in the wall of the overlap region. The measurements showed no correlation with any of the periodic structural motion. In addition, self-excitation occurred even when the overlap region was eliminated and only the very short annular region of the constriction remained.

Subsequent shaker tests of the sparger added to the understanding of the structural motion. Because of the complex support system small axial movements of the thermal sleeve could be responsible for large lateral motion of the main sparger. As a result, an excitation mechanism based on axial movement of the thermal sleeve was theoretically postulated and found to exist in a model experiment [24]. Although this was not necessarily the excitation mechanism for the sparger, it is another mechanism to be aware of in a design review.

OTHER CONFIGURATIONS

One of the earliest reactor industry identifications of leakage flow as a vibration excitation mechanism was made during an investigation of the loosening (broken retainer bolts) at the supports of a cylindrical shell serving as a thermal shield between reactor core and pressure vessel wall [26]. The annulus between the thermal shield and the pressure vessel was subject to the constant pressure drop developed by flow through the reactor core; leakage flow occurred after a threshold core pressure drop was exceeded. The geometric and flow configurations were very similar to (a) of the Figure, in which the rigid body translation of the inside tube represents movement of the thermal shield, the outside tube represents the stationary vessel wall, and the constriction at the entrance to the annular region represents the broached seal at the entrance to the annular region. Not surprisingly, the qualitative results were the same as before. For a sufficiently large leakage flow (pressure drop) an instability was possible for an entrance constriction; an exit constriction would not create an instability, however, because it always produces positive fluid damping. The instability was eliminated in the reactor by modifying the bottom seal to reduce the rate of leakage flow and by adding a top seal to provide positive fluid damping.

In the mid 1970s flow-induced vibrations were found to cause unacceptable wear damage in a jet pump of a boiling water reactor. The problem was corrected by a substantial research effort [27-29] consisting primarily of full-scale component tests outside the reactor. The excitation mechanism was identified with the leakage flow through a slip joint required to avoid large thermal stresses. The slip joint was close to the center of the jet pump and had a geometry similar to (a) of the Figure except that the overlap region was very short (on the order of the length of the constriction) and the width of the overlap annulus expanded in the downstream direction like an annular diffuser. The vibration modes of the jet pump were complex, and both translation and rotation of the pipes at the slip joint were possible. Any of the mechanisms discussed previously for the geometry of (a) of the Figure could have been active at the slip joint of the jet pump, but a specific mechanism could not be expected to be identified in a test of such a complex system.

At least one important observation was made, however; the initiation of unstable motion was temperature (Reynolds number) sensitive. Apparently the hydraulic resistance (fluid viscosity) in the slip joint is lowered at higher temperatures and the leakage flow kinetic energy necessary for an instability can be attained at a smaller pressure drop. In one jet pump test, the excitation mechanism was not active until the temperature (Reynolds number) was raised close to prototypic values.

SUMMARY

The strong dependence of leakage flow path excitation mechanisms on the details of the flow paths and structural motion should now be apparent to the reader. Qualitative trends could be defined; however, generalization of information gained for one design to another design must be done with care. Even when the flow geometry appears identical, structural motion also must be similar.

The mechanisms identified and researched to date have been for relatively simple structural motions: the vibration (translation or rotation) of a single-degree-of-freedom rigid body ideally positioned in a rigid, stationary flow channel. All the analytical and experimental evidence now available, which is not a lot, indicates that more complicated vibration modes and geometric eccentricities might greatly influence the existence of known instability mechanisms or create new ones. These influences perhaps explain the lack of capability to analytically predict experiment results.

There is little doubt that scale model testing will have to be performed before any suspected leakage flow mechanism or problem experienced during reactor operation can be understood. If more than qualitative identification of a mechanism by scale model testing is desired, the conflicting requirements of simulating both reduced velocities and Reynolds number necessitate [30] testing of prototypic structures including full geometric scale with flows at operating temperatures. These modeling requirements, which lead to very expensive tests, can sometimes be relaxed in design verification testing by justifying that a distorted model is more likely to experience flow-induced vibrations than the prototype.

This review demonstrates the strong dependence of leakage flow mechanisms on the details of flow geometry and structural motion. The difficulty of identifying excitation mechanisms with particular geometries and conditions, and expensive model testing or repair of operating reactors is typical. Thus, reactor component supports that create leakage flow paths should be limited to a few designs which have been shown by comprehensive experimental and analytical research to be free of FIV excitation mechanisms.

ACKNOWLEDGMENT

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BOOK REVIEWS

REFERENCE DATA FOR ACOUSTIC NOISE CONTROL

W.L. Ghering
Ann Arbor Science Publ., Ann Arbor, MI
1980, 152 pp, $39.95

Noise control problems confront engineers in many different fields; often they do not have the necessary information to deal with such problems effectively. This book is an attempt to assemble all essential reference data for solving noise control problems into one volume. All important aspects of noise control are covered. Such topics as noise level estimation, transmission loss, structural radiation, response to sound, and statistical energy analysis are covered adequately. Chapter titles listed in the Table of Contents are:

1. Description of Noise
2. Noise Level Estimation
3. Acoustic Information
4. Transmission Loss
5. Barriers, Enclosures, Partial Enclosures, Hoods
6. Standards
7. Noise Control Recommendations
8. Effects of Noise on People
9. Special Noise Sources
10. Structural Radiation and Response to Sound
11. Statistical Energy Analysis (SEA)

For those who need more information, the author provides additional references from the literature. The book is well written and illustrated; it is logically organized. Both the practitioner and the novice will want this reference book.

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NOISE CONTROL IN INTERNAL COMBUSTION ENGINES

D.E. Baxa, Editor
John Wiley and Sons, Inc., New York, NY
1982, 511 pp, $54.50

This guide contains information on noise control in internal combustion engines and related hardware. A methodology for investigating, evaluating, and designing controls for noise in engines is given. The chapters are written by experts in the field.

The book is organized in two sections. The first section surveys the history of the engine and its evolution to its present configuration. Various operating parameters and their effects on engine noise levels are examined. Such noise control approaches as silencers and damping are discussed. The editor is to be congratulated for including damping materials. Damping can often be used to solve noise and vibration problems in a cost-effective and time-efficient manner. Sound measurement instruments and facilities are considered as well as procedures to evaluate sound.

The second section deals with noise control by components, including brakes, gears, and bearings. The chapter on sound and vibration monitoring for quality control contains information on good monitoring practices that maintain quality standards.

Excellent references are given at the end of each chapter for the inquiring reader. Each chapter also contains an extensive outline of the material that is to be presented and nomenclature of terms and variables used. The book is clearly the work of a team of high-quality professionals, is well written, and contains many helpful figures and tables. The industrial engineer as well as the mechanical engineer working with engines will want a copy of this text.

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APPLIED MECHANICAL VIBRATIONS

D.V. Hutton
McGraw-Hill Book Co., New York, NY
1981, 336 pp

The purpose of this book is to present the basic theory of vibrations in an orderly fashion and to provide insights into the theory of vibration. The practical nature of vibration is the theme of the book. As sated by the author, "The text is not meant to cover the entire field of vibration. Rather it covers the basic areas important to the field and necessary for successful study of specialized advanced topics." He considers vibration theory and provides examples and sample problems.

The book consists of eleven chapters and two appendices. Chapter 1 has to do with Newton's law of motion in one and two dimensions. Chapter 2 treats the basic methods of solving second order, ordinary differential equations with constant coefficients. The next chapter treats the basic theory of free vibration of undamped single-degree-of-freedom systems using simple harmonic motion. The author stresses the relationship between natural frequency and the physical parameters of the system. He introduces energy methods and the approximate technique to illustrate the effects of massless springs.

Chapter 4 contains a description of the response to a harmonic forcing function and a brief discussion of beating and resonance effects applied to the single-degree-of-freedom system. Chapter 5 presents the concept of damping in mechanical systems, including viscous, coulomb, and structural damping. The chapter concludes with an interesting discussion of free and forced vibration and the concept of equivalent viscous damping.

Chapter 6 contains an interpretation of vibration data of rotating systems as applied to field measurements. The author introduces simple instrumentation for obtaining vibration data from frequency analysis. Dynamic balancing procedures employed in single-phase and two-plane balancing are given. Most vibration texts neglect this important topic.

The following chapter describes the proper methods for analyzing system response to nonharmonic forcing function, including the Fourier series, response to unit impulse employing the Dirac delta function, the Laplace transform, and the convolution integral.

Chapter 8 is concerned with vibrations of systems with two degrees of freedom. Topics include free undamped motion, principal modes, coupling with principle coordinates, damped and undamped vibration absorbers, and forced vibrations of a damped system with two degrees of freedom. Chapter 9 treats in detail the fundamentals and applications of electronic analog computers.

Chapter 10 deals with vibrations of multi-degree-of-freedom systems and digital computer techniques. Lagrange equations are derived and used to derive equations of motion, which are written in matrix form. The principle mode method is introduced and orthogonality is considered. Rayleigh's method is explained and applied to three-degreee-of-freedom systems. Initial value problems, normalization of the modal matrix, and forced vibrations of undamped systems are described. The author illustrates matrix operations in FORTRAN. The reviewer feels that Dunkerley's method, Holzer's method applied to torsional vibration, the transfer matrix, and the combination of digital and analog systems should have been included.

The concluding chapter treats vibrations of continuous media. The wave equation, longitudinal and torsional vibration, and transverse vibration of a beam are discussed. The chapter contains a good discussion of Fourier series: the delta function applied to impulsive concentrated loading and applied to a beam. The chapter concludes with a short section on approximate methods. The reviewer believes that this chapter should have included a brief introduction to finite element methods as applied to beam vibration problems. No mention is made of the Rayleigh-Ritz or Galerkin procedure.

The appendices treat the mathematical details of mass moment of inertia, Fourier series, matrix algebra, and the use of Laplace transforms to solve linear differential equation. FORTRAN programs constitute the second part of the appendix. A number of programs are furnished, but the reviewer feels that the explanations of these programs are too short and should have been expanded for the benefit of the beginning student.

The author does present an elementary text on vibrations. However, the additions suggested by the reviewer would have enhanced the book.

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PROGRAMMING METHODS IN STRUCTURAL DESIGN

N.G.R. Iyengar and S.K. Gupta
Affiliated East-West Press Pvt. Ltd., New Delhi-Madras
1980, 248 pp

This book consists of four parts. Part I is a brief introduction on optimum design. Part II is about structural analysis. Part III has to do with optimization techniques, and Part IV is concerned with structural applications. Parts II and III are included as backup material for structural applications, most of which are the outcome of theses of Indian Institute of Technology, Kanpur.

Part II on structural analysis contains the following topics: buckling of columns and plates, vibrations of beams and plates, and random vibration. In some cases the theory is completely derived; in others elaborate derivations are omitted. Part II might be unnecessary for an undergraduate or postgraduate text because the student is expected to have some background in mechanics of materials and vibration analysis before taking a course on optimum design of structures.

Part III deals with optimization techniques: linear programming, nonlinear programming, geometric programming, and dynamic programming. The techniques are described; the examples given, however, are nonstructural in nature and can be found in other books. Nevertheless, Part III contains useful information that can be prescribed to a special elective course in this area.

Part IV deals with special applications on optimization of structures as worked out at the Institute at Kanpur. Each chapter consists of a case study: thin-walled columns, multicell box beams, multicell wings for strength and frequency requirements, grid floor, wing structures, cantilever beam under random load, water tank staging under earthquake and wind load conditions, and sheet stringer panels under a jet noise pressure field. A problem of nonlinear free vibration of beams could have been treated in Part II. Part IV will be more useful to a practicing engineer than to a student, as each case is presented in the form of a research paper.

The reviewer would like to caution the reader about a large number of printing errors. These include:

- confusion in notations

  δ and ∂ are both used to denote variational parameter

  ν and ω are used to denote deflection in deriving Timoshenko beam theory

  '- dash is used simultaneously to denote partial differentiation with respect to x and y

- errors in printing

  $$\frac{\partial U_b}{\partial A_1} - \frac{1}{2}\omega^2 \frac{I}{A_1} = 0$$ which should read

  $$\frac{\partial U_b}{\partial A_1} - \frac{1}{2}\omega^2 \frac{\partial I}{\partial A_1} = 0$$

  $\int_{t_1}^{t_2} L dt = 0$ which should be $\delta \int_{t_1}^{t_2} L dt = 0$

- logical errors

  Levy type of solution is introduced on p 40 without specifically mentioning the name, but introduced later on p 73.

  p(z) is introduced as inertial loading in the derivation of beam theory. The author then says that p(z) is replaced by inertia force

Energy methods are mentioned for obtaining approximate values; finite difference and finite element methods are introduced as numerical techniques

(thereby implying energy methods are not numerical techniques, even though Hamilton's principle is used *in deriving finite element methods*). Both english and metric units are used in the text.

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SHORT COURSES

OCTOBER

UNDERWATER ACOUSTICS AND SIGNAL PROCESSING

Dates: October 3-7, 1983
Place: University Park, Pennsylvania

Objective: This course is designed to provide a broad, comprehensive introduction to important topics in underwater acoustics and signal processing. The primary goal is to give participants a practical understanding of fundamental concepts, along with an appreciation of current research and development activities. Included among the topics offered in this course are: an introduction to acoustics and sonar concepts, transducers and arrays, and turbulent and cavitation noise; an extensive overview of sound propagation modeling and measurement techniques; a physical description of the environment factors affecting deep and shallow water acoustics; a practical guide to sonar electronics; and a tutorial review of analog and digital signal processing techniques and active echo location developments.

Contact: Alan D. Stuart, Course Chairman, Applied Research Laboratory, The Pennsylvania State University, P.O. Box 30, State College, PA 16801 - (814) 865-7505.

VIBRATION AND SHOCK SURVIVABILITY, TESTING, MEASUREMENT, ANALYSIS, AND CALIBRATION

Dates: October 17-21, 1983
Place: England
Dates: October 24-28, 1983
Place: Boulder, Colorado
Dates: November 21-25, 1983
Place: Ottawa, Ontario
Dates: November 28 - December 3, 1983
Place: Cincinnati, Ohio
Dates: December 5-9, 1983
Place: Santa Barbara, California
Dates: February 6-10, 1984
Place: Santa Barbara, California
Dates: March 5-9, 1984
Place: Washington, D.C.

Objective: Topics to be covered are resonance and fragility phenomena, and environmental vibration and shock measurement and analysis; also vibration and shock environmental testing to prove survivability. This course will concentrate upon equipments and techniques, rather than upon mathematics and theory.

Contact: Wayne Tustin, 22 East Los Olivos Street, Santa Barbara, CA 93105 - (805) 682-7171.

ELECTROEXPLOSIVES DEVICES TRAINING COURSE

Dates: October 18-20, 1983
Place: Philadelphia, Pennsylvania

Objective: Topics will include but not be limited to the following: history of explosives and definitions; types of pyrotechnics, explosives and propellants; types of EEDs, explosive trains and systems, fuzes, safe-arm devices; sensitivity and functioning mechanisms; output and applications; safety versus reliability; hazard sources: lightning, static electricity, electromagnetic energy (RF, EMP, light, etc.), heat, flame, impact, vibration, friction, shock, blast, ionizing radiation, hostile environments, human error; precautions, safe practices, standard operating procedures; grounding, shorting, shielding; inspection techniques, system check-out troubleshooting and problem solving; safety devices, packaging and transportation; specifications, documentation, information sources, record keeping; tagging, detection and identification of clandestine explosives; reaction mechanisms, solid state reactions; chemical deactivation, disposal methods and problems, toxic effects; laboratory analytical techniques and instrumentation; surface chemistry.

Contact: E&P Affairs, The Franklin Research Center, 20th and Race Streets, Philadelphia, PA 19103 - (215) 448-1236.

DYNAMIC BALANCING

Dates: October 19-20, 1983
November 16-17, 1983

Place: Columbus, Ohio

Objective: Balancing experts will contribute a series of lectures on field balancing and balancing machines. Subjects include: field balancing methods; single, two and multi-plane balancing techniques; balancing tolerances and correction methods. The latest in-place balancing techniques will be demonstrated and used in the workshops. Balancing machines equipped with microprocessor instrumentation will also be demonstrated in the workshop sessions. Each student will be involved in hands-on problem-solving using the various balancing techniques.

Contact: R.E. Ellis, IRD Mechanalysis, Inc., 6150 Huntley Road, Columbus, OH 43229 - (614) 885-5376.

NOVEMBER

MACHINERY VIBRATION ENGINEERING

Dates: November 1-4, 1983

Place: Cincinnati, Ohio

Objective: Techniques for the solution of machinery vibration problems will be discussed. These techniques are based on the knowledge of the dynamics of machinery; vibration measurement, computation, and analysis; and machinery characteristics. The techniques will be illustrated with case histories involving field and design problems. Familiarity with the methods will be gained by participants in the workshops. The course will include lectures on natural frequency, resonance, and critical speed determination for rotating and reciprocating equipment using test and computational techniques; equipment evaluation techniques including test equipment; vibration analysis of general equipment including bearings and gears using the time and frequency domains; vibratory forces in rotating and reciprocating equipment; torsional vibration measurement, analysis, and computation on systems involving engines, compressors, pumps, and motors; basic rotor dynamics including fluid film bearing characteristics, critical speeds, instabilities, and mass imbalance response; and vibration control including isolation and damping of equipment installation.

Contact: The Vibration Institute, 101 West 55th Street, Clarendon Hills, IL 60514 - (312) 654-2254.

LECTURE/TRAINING COURSE ON NAVAL SHOCK

Dates: November 14-18, 1983

Place: Washington, D.C.

Dates: January 9-13, 1984

Place: San Diego, CA

Objective: Combat survivability is a key issue in the design of naval ships. Current DoD policy highlights survivability as an essential requirement in the ship acquisition process. The wars in South East Asia, the Middle East and, recently, in the Falkland Island conflict accentuated the need for combat survivability. Since shock induced by various weapons is a major and highly destructive weapon effect, design for survival under shock is a vital part of the ship survivability process. Hence, under present Navy policy, all mission-essential equipment must qualify to rigorous shock hardening requirements. Naval Systems Commands and Laboratories, shipbuilders and equipment suppliers all play a role in the shock hardening process. If you work for the Navy, you may be involved in the implementation and verification of the Navy shock requirements, or you may be responsible for the purchase of electronic or weapon systems that must be shock qualified. As an employee of a major shipbuilder or a Naval equipment supplier, you may be faced with broad and/or specific aspects of Naval shock design. This lecture/training course has been developed to help engineers, scientists, Naval architects and others understand and effectively deal with the U.S. Navy's ship shock hardening requirements. If you are faced with ship shock problems, participation in this course should increase your value to your organization and enhance your own career advancement.

Contact: Henry C. Pusey or Maurisa Gohde, NKF Engineering Associates, Inc., 8150 Leesburg Pike, Suite 700, Vienna, VA 22180 - (703) 442-8900.

MACHINERY VIBRATION ANALYSIS

Dates: November 15-18, 1983

Place: Chicago, Illinois

Objective: In this four-day course on practical machinery vibration analysis, savings in production losses and equipment costs through vibration analysis and correction will be stressed. Techniques will be reviewed along with examples and case histories to illustrate their use. Demonstrations of measurement and analysis equipment will be conducted during the course. The course will include lectures on test equipment selection and use, vibration measurement and analysis including the latest information on spectral analysis, balancing, alignment, isolation, and damping. Plant predictive maintenance programs, monitoring equipment and programs, and equipment evaluation are topics included. Specific components and equipment covered in the lectures include gears, bearings (fluid film and antifriction), shafts, couplings, motors, turbines, engines, pumps, compressors, fluid drives, gearboxes, and slow-speed paper rolls.

Contact: The Vibration Institute, 101 West 55th Street, Suite 206, Clarendon Hills, IL 60514 - (312) 654-2254.

DECEMBER

SCALE MODELING IN ENGINEERING DYNAMICS

Dates: December 5-9, 1983
Place: Washington, D.C.
Objective: The course will begin with a drop test demonstration of damage to model and prototype cantilever beams made from different materials. These tests help to introduce the concepts of similarity and of physical dimensions which are preliminary to any model analysis. Formal mathematical techniques of modeling will then be presented including the development of scaling laws from both differential equations and the Buckingham Pi Theorem. A number of sessions then follow wherein the instructors present specific analyses relating to a variety of dynamic vibrations and transient response problems. The problems are selected to illustrate the use of models as an analysis tool and to give examples of variations on different modeling techniques. Types of problems presented include impact, blast, fragmentation, and thermal pulses on ground, air and floating structures.

Contact: Wilfred E. Baker, Southwest Research Institute, P.O. Box 28510, San Antonio, TX 78284 - (512) 684-5111, Ext. 2303.

RELIABILITY DESIGN TRAINING COURSE

Dates: December 12-15, 1983
Place: Orlando, Florida
Objective: The course introduces the basic concepts and theory of reliability engineering along with rudimentary mathematical relationships and emphasizes the practical application of reliability tools which can be used by the designer. Major elements contained in the course include: part selection, specification and control (including screening and qualification); part derating and derating guidelines; reliability allocation and prediction; reliability analysis including FMECA's and fault trees; reliability testing including formal demonstration testing; reliability program management; reliability design techniques such as redundancy and environmental protection, design simplification and analysis; maintenance and maintainability considerations; CMOS and electrostatic discharge considerations; and life cycle cost and design-to-cost philosophies.

Contact: Ms. Nan Pfrimmer, Reliability Analysis Center, RADC/RAC, Griffiss AFB, NY 13441 - (315) 330-4151.

NEWS BRIEFS: news on current and Future Shock and Vibration activities and events

SAE TECHNICAL COMMITTEE G-5 PROGRAM ON ADVANCES IN DYNAMIC TESTING AND ANALYSIS

The following is the one-day program on "Advances in Dynamic Testing and Analysis," to be held October 4, 1983 during the SAE Aerospace Congress and Exposition at the Long Beach Convention Center, Long Beach, California, October 3-6, 1983. The sessions were planned by the SAE Technical Committee G-5 Aerospace Shock and Vibration.

PART I - 9:00 A.M.

Chairman: Dr. C. Thomas Savell, Dynamic Analysis & Testing Associates
Asst. Chairman: David L. Hunt, Structural Dynamics Research Corporation

Special Analysis of Dynamic Data through Nonlinear Systems - Dr. Julius S. Bendat, J.S Bendat Co.

The Development of Fast Flow (A Program for Flutter Optimization to Satisfy Multiple Flutter Requirements) - Bruce A. Rommel, Douglas Aircraft Co.

Acoustic Structural Interaction Using NASTRAN - Dr. C. Thomas Savell, Dynamic Analysis & Testing Associates; Mladin K. Chargin

Pressure Transients in Aerial Refueling Systems - Prof. M.E. Franke, Dept. of Aeronautics, Air Force Institute of Technology, Capt. T.J. Carter, III, Air Force Wright Aeronautical Laboratories

Predicting Dynamic Instability Boundaries Using Lattice Filters - Bruce H. Wendler, Lockheed-California Co.

Analysis of Space Shuttle Landing Accelerations - Roy W. Mustain, Rockwell International

PART II - 2:00 P.M.

Chairman: Dr. Gerard C. Pardoen, University of California at Urvine, Civil Engineering
Asst. Chairman: Harry Himelblau, Rockwell International

Multi-Shaker Broadband Excitation for Experimental Modal Analysis - David L. Hunt and Edward L. Peterson, Structural Dynamics Research Corporation

Measured Modal Damping of Spacecraft under Low-Amplitude Vibration - Dr. Stepan S. Simonian, TRW

Force Appropriation - Application of Extended Asher's Method - Dr. Paul Ibanez, ANCO Engineers

Galileo Spacecraft Modal Test - Dr. Jay C. Chen and Marc Trubert, Jet Propulsion Laboratories

Characterizing the Vibratory Output of a Multi-Terminal Machine and Predicting the Vibration Amplitudes of the Supporting Structure - Dr. Alan O. Sykes, Consultant

For further information contact Roy W. Mustain, Vice Chairman, SAE Committee G-5, Rockwell International Space Systems Group, 12214 S. Lakewood Blvd., AB97, Downey, CA 90241.

IAVD CONGRESS ON VEHICLE AND COMPONENT DESIGN
February 27-29, 1984
Geneva

The International Association for Vehicle Design has been invited to organize an annual prestigeous congress concurrent to the Geneva Motor Show. The 1984 congress will be held in Geneva during the period February 27-29, 1984. The theme of the congress is "Future Development in Vehicle and Component Design." The program of the congress

includes: keynotes and invited addresses (the theme is "Future Trends in Vehicle and Component Design") and three parallel conferences:

- Conference A on "Materials and Composites" (steel, aluminium, plastics, ceramics, etc . . .)
- Conference B on "Electronics and Vehicle Controls" (engine and transmission control, etc . . .)
- Conference C on "Energy and Efficiency; Economy; Safety and Environment"

For further information contact: Dr. M.A. Dorgham, International Association for *Vehicle Design*, The Open University, Walton Hall, Milton Keynes MK7 6AA - Telephone: (0908) 653945.

ADVANCE PROGRAM

54th SHOCK AND VIBRATION

SYMPOSIUM

October 18-20, 1983

Pasadena, California

Host
Jet Propulsion Laboratory
on behalf of
National Aeronautics and Space Administration

THE SHOCK AND VIBRATION
INFORMATION CENTER

GENERAL INFORMATION

CONFERENCE LOCATION: Registration information for technical sessions is at the Huntington Sheraton Hotel, Pasadena, California.

REGISTRATION: Registration fee covers the cost of the proceedings of the 54th Shock and Vibration Symposium. There is no fee for SVIC Annual Subscribers* or for participants. Since the registration fee covers only the cost of the proceedings, there will be no reduced fee for part time attendance. The schedule of fee is as follows:

Subscriber Registration (for employees
of SVIC Annual Subscribers*) . . . . No Fee
Participant Registration (Authors,
Speakers, Chairmen, Cochairmen). . . . . . . No Fee
General Registration (All others)
(Payable to Disbursing Officer, NRL) . . . $140.00

On-Site Registration: Pre-registrants may obtain their badges or last minute registration may be accomplished at the following times:

Huntington Sheraton Hotel
Monday, October 17 . . . . . 7:00 p.m. - 9:00 p.m.
Tuesday, October 18 . . . . . 7:30 a.m. - 4:00 p.m.
Wednesday, October 19 . . . 8:00 a.m. - 4:00 p.m.
Thursday, October 20 . . . . 8:00 a.m. - 2:00 p.m.

INFORMATION: The information and message center will be located in the registration area. The phone number of the hotel is (213) 792-0266. Telephone messages and special notices will be posted near the registration desk. All participants should check regularly for messages or timely announcements. Participants will not be paged in the sessions.

COMMITTEE MEETINGS: Space is available to schedule meetings for special committees and working groups at the Symposium. To reserve space, contact SVIC. A schedule of special meetings will be posted on the Bulletin Board.

SVIC STAFF:

Dr. J. Gordan Showalter, Acting Director
Mr. Rudolph H. Volin
Mrs. Jessica P. Hileman
Mrs. Elizabeth McLaughlin
Mrs. Mary Gobbett

Shock and Vibration Information Center
Naval Research Laboratory, Code 5804
Washington, DC 20375

Telephone: (202) 767-2220
Autovon: 297-2220

SUMMARIES OF PRESENTED PAPERS: These will be available to all attendees at the time of registration. These summaries are longer than the usual abstract and contain enough detail to evaluate their usefulness to you as an individual. By reading these in advance of the sessions, you may more effectively choose the papers you wish to hear.

SHOCK AND VIBRATION BULLETIN No. 54: Papers presented at the 54th Symposium will, at the author's request, be reviewed and published in the Bulletin after approval by two reviewers. The discussion following these papers will be edited and published with the respective papers. Registrants who have paid the registration fee or have satisfied the registration requirements will receive a copy of the Bulletin. Additional sets of the 54th Bulletin will be sent to Annual Subscribers. Others may purchase the Bulletin from the Shock and Vibration Information Center. The price is $140.00 for each set delivered in the United States.

OTHER PUBLICATIONS: Sample copies of current publications of the Shock and Vibration Information Center may be examined at the registration area. Order blanks are available for those wishing to use them.

54th SYMPOSIUM PROGRAM COMMITTEE

Mr. Brian Keegan
Code 302
NASA Goddard Space Flight Center
Greenbelt, MD 20771

Dr. Benjamin Wada
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A SVIC Annual Subscriber is an organization that has purchased the SVIC Annual Subscription Service Package for Fiscal Year 1984 (1 October 1983 - 30 September 1984).

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Mr. Jerome Pearson
Air Force Wright Aeronautical Labs
AFWAL/FIBG
Wright-Patterson AFB, OH 45433

Mr. David Hurt
Code 55X
Naval Sea Systems Command
Washington, DC 20362

Opening Session **Tuesday, October 18**
8:30 a.m. **Viennese Room**

Chairman: Dr. Ben Wada, The Jet Propulsion Laboratory, Pasadena, CA

Cochairman: Dr. J. Gordan Showalter, Shock and Vibration Information Center, Naval Research Laboratory, Washington, DC

This session is still being planned. Details will appear in the final program.

Plenary A **Tuesday, October 18**
2:00 p.m. **Georgian Room**

Chairman: Dr. J. Gordan Showalter, Shock and Vibration Information Center, Naval Research Laboratory, Washington, DC

Speaker: Mr. Strether Smith, Lockheed Palo Alto Research Laboratory, Palo Alto, CA

Subject: *Modal Testing*

Session 1A **Tuesday, October 18**
3:00 p.m. **Wentworth Room**

SHIP SHOCK

Chairman: Dr. Melvin Baron, Weidlinger Associates, New York, NY

Cochairman: Mr. Gene Remmers, David Taylor Naval Ship R&D Center, Bethesda, MD

1. Survey of Naval Biodynamics Laboratory with Emphasis on Testing Humans for Shock Survival – C. EWING, Naval Biodynamics Laboratory

2. Two-Dimensional Shock Response of a Mass on Energy-Absorbing Shock Mounts – R. FORTUNA and V.H. NEUBERT, The Pennsylvania State University, University Park, PA

3. Optimum Design for Nonlinear Shock Mounts for Shock Barge Inputs – K. KASRAIE and V.H. NEUBERT, The Pennsylvania State University, University Park, PA

4. Designing Shock Resistance into a Complex Submarine Subsystem – A.K. DAVENPORT, Hamilton Standard, Division of United Technologies Corporation, Windsor Locks, CT

5. The Development of a Method for the Shock Resistant Securing of Large Batteries in Submarines - A. JANSEN, Royal Netherlands Navy, The Netherlands

6. Shipboard Shock Response of the Modelstructure DSM; Experimental Results Versus Responses Predicted by Eight Participants – R. REGOORD, TNO-IWECO, The Netherlands

Session 1B **Tuesday, October 18**
3:00 p.m. **Georgian Room**

SPACE VIBRATION

Chairman: Mr. Jerome Pearson, AFWAL, Wright-Patterson AFB, OH

Cochairman: Mr. John Garba, Jet Propulsion Laboratory, Pasadena, CA

1. Invited paper from Lockheed Missile & Space Co., Sunnyvale, CA

2. Invited paper from TRW, Redondo Beach, CA

3. Transient Vibration Test Criteria for Spacecraft Hardware – C.D. HAYES, Jet Propulsion Laboratory, Pasadena, CA

4. Water Impact Laboratory and Flight Test Results for the Space Shuttle Solid Rocket Booster Aft Skirt – D.A. KROSS, NASA Marshall Space Flight Center, Huntsville, AL; N.C. MURPHY, United Space Boosters, Inc., Huntsville, AL; and E.A. RAWLS, Chrysler Corporation, New Orleans, LA

5. Time Dependent Dynamic Response Characteristics of the Shuttle Thermal Protection System – H.C. MERCHANT and W.J. LOVE, University of Washington, Seattle, WA; A.C. HANSEN, Montana State University, Bozeman, MT; and C.F. CHIU, Phillips Corporation, Taipei, Taiwan

6. Preliminary Modal Identification Studies for a Large Space Antenna Flight Experiment – R.S. PAPPA and W.H. GREENE, NASA Langley Research Center, Hampton, VA

Plenary B **Wednesday, October 19**
8:30 a.m. **Georgian Room**

Chairman: Mr. William Walker, Boeing Corporation, Seattle, WA

Speaker: Dr. George Morosow, Martin Marietta Corporation, Denver, CO

Subject: Solutions to Structural Dynamics Problems

Session 2A **Wednesday, October 19**
9:40 a.m. **Wentworth Room**

STRUCTURAL DYNAMICS

Chairman: Mr. Edward Fleming, Aerospace Corporation, Los Angeles, CA

Cochairman: Dr. John Gubser, McDonnell Douglas Astronautics Company, St. Louis, MO

1. Structural Modifications by Viscoelastic Elements – P.J. RIEHLE, Anatrol Corporation, Cincinnati, OH

2. A Macroscopic Equivalent Coating Model for Use in Large Scale Acoustic-Structure Interaction Computations – A.J. KALINOWSKI, Naval Underwater Systems Center, New London, CT

3. Determination of Resonant Frequencies Using Dynamic Condensation – M. PAZ and C. MALPARTIDA, University of Louisville, KY

4. Direct Energy Minimization Approach to Whipping Analysis – K.A. BANNISTER, Naval Surface Weapons Center, White Oak, Silver Spring, MD

5. Free Vibration of Deep Cylindrical Shells – J.K. LEE and A.W. LEISSA, Ohio State University, Columbus, OH

6. Modal Analysis of Structural Systems Involving Nonlinear Coupling -- R.A. IBRAHIM and T.D. WOODALL, Texas Tech. University, Lubbock, TX

7. Discrete Modifications to Continuous Dynamic Structural Systems -- Y. OKADA, B.P. WANG, and W.D. PILKEY, University of Virginia, Charlottesville, VA

Session 2B **Wednesday, October 19**
9:40 a.m. **Georgian Room**

MIL-STD-810D, SESSION I, RATIONALE

Chairman: Mr. John Wafford, Wright-Patterson AFB, OH

Cochairman: Mr. Robert Hancock, Vought Corporation, Dallas, TX

1. The New Shock Philosophy of MIL-STD-810D -- S. RUBIN, The Aerospace Corporation, Los Angeles, CA

2. Impact of MIL-STD-810D on the Testing Process – D.L. EARLS, A.H. Burkhard, and P.S. HALL, Wright Aeronautical Laboratories, Wright Patterson Air Force Base, OH

3. Acceleration Responses of Typical LRU's Subjected to Bench Handling and Installation Shock – H. CARUSO and E. SZYMKOWIAK, Westinghouse Electric Corporation, Baltimore, MD

Additional papers on the sources and types of dynamic environmental data available for several types of vehicles are planned for this session. Details will be published in the final program.

Session 3A **Wednesday, October 19**
2:00 p.m. **Wentworth Room**

SHOCK

Chairman: Mr. Ami Frydman, Harry Diamond Laboratories, Adelphi, MD

Cochairman: Mr. Brian Keegan, NASA Goddard Space Flight Center, Greenbelt, MD

1. Application of a Simple Error Measure for the Comparison of Calculated and Measured Transient Response Histories – T.L. GEERS, Lockheed Palo Alto Research Laboratory, Palo Alto, CA

2. Alternative Shock Characterization for Consistent Shock Test Specification -- T.J. BACA, Sandia National Laboratories, Albuquerque, NM

3. Low Velocity, Explosively Driven Flyer Plates for Impact Fuze Experiments – R.A. BENHAM, Sandia National Laboratory, Albuquerque, NM

4. Verification of a Modeling Program with Shock Mitigation Calculations -- L.H. LOWE, Los Alamos National Laboratory, Los Alamos, NM

5. Experimental Investigation of Vibroimpact of Two Oscillators – C.N. BAPAT and S. SANKAR, Concordia University, Montreal, Quebec, Canada

6. Models for Shock Induced Damage to Marine Structural Materials – D.W. NICHOLSON, Naval Surface Weapons Center, Silver Spring, MD

7. Numerical Generation of Transient Acoustic Fields with Non-Spherical Wave Fronts – T.L. GEERS, J.A. DE RUNTZ, and W.C. PERRY, Lockheed Palo Alto Research Laboratory, Palo Alto, CA

8. A Study of the Effect of Mass Loading on the Shock Environment -- H.B. LIN and Q.Z. WANG, Chinese Academy of Space Technology, Beijing, China

Session 3B **Wednesday, October 19**
2:00 p.m. **Georgian Room**

MIL-STD-810D, SESSION II, IMPLEMENTATION AND USE

Chairman: Mr. Rudolph H. Volin, Shock and Vibration Information Center, Naval Research Laboratory, Washington, DC

Cochairman: Mr. Peter Bouclin, Naval Weapons Center, China Lake, CA

MIL-STD-810D radically departs from its predecessors in many ways, and one of the most significant changes is the emphasis on the use of measured data to derive laboratory test requirements. The purposes of this session are to discuss the methods for developing laboratory test specifications using the provisions of this standard, and to discuss some of the practical problems that might arise in conducting laboratory tests using the provisions of this standard. Time will be available for an extended discussion of all facets of this standard following the presentations in this session.

Plenary C **Thursday, October 20**
8:30 a.m. **Georgian Room**

Chairman: Mr. William Flathau, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS

Speaker: Dr. Wilfred E. Baker, Southwest Research Institute, San Antonio, TX

Subject: Blast and Ground Shock

Session 4A **Thursday, October 20**
9:40 a.m. **Wentworth Room**

BLAST/GROUND SHOCK

Chairman: Mr. William Flathau, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS

Cochairman: Mr. George Coulter, Ballistic Research Laboratory, Aberdeen Proving Ground, MD

1. Assessment of Seismic Survivability – R.E. McCLELLAN, The Aerospace Corporation, Los Angeles, CA

2. Statistical Analysis of the Dynamic Response of Underground Arches Subject to Blast Loading – F.W. WONG and E. RICHARDSON, Weidlinger Associates, Menlo Park, CA

3. Ground Shock Effect on Soil Field Inclusion -- R.E. McCLELLAN, The Aerospace Corporation, Los Angeles, CA

4. Evaluation of Survivability of Multiple Facilities Attacked by Multiple Weapons, J.D. COLLINS, Acta, Inc., Harbor City, CA

5. Penetration of Short Duration Airblast into Protective Structures – J.R. BRITT and J.L. DRAKE, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS

6. A Computational Procedure for Peak Instructure Motions and Shock Spectra for Conventional Weapons – S.A. KIGER, J.P. BALSARA, and J.T. BAYLOT, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS

Session 4B **Thursday, October 20**
9:40 a.m. **Georgian Room**

MACHINERY DYNAMICS

Chairman: Dr. Edward Gunter, University of Virginia, Charlottesville, VA

Cochairman: Dr. David Fleming, NASA Lewis Research Center, Cleveland, OH

1. Dynamic Response of Multi-Rotor Systems Mounted in Bearings with Negative Cross Coupled Stiffness Coefficients – A.M. SHARAN and J.S. RAO, Memorial University, St. John's, Newfoundland

2. Gear Case Vibration Isolation in a Geared Turbine Generator – R.P. ANDREWS, Westinghouse Electric Corp., Marine Division, Sunnyvale, CA

3. Effect of Coupled Torsional-Flexural Vibration of a Geared Shaft System on the Dynamic Tooth Load – S.V. NEVIYA, R.B. BHAT, T.S. SANKAR, Concordia University, Montreal, Quebec, Canada

4. Precision Measurement of Torsional Oscillations Induced by Gear Errors -- S.L. SHMUTER, Ford Motor Co., Detroit, MI

5. The Analysis by the Lumped Parameter Method of Blade Platform Friction Dampers Used in the High Pressure Fuel Turbopump of the Space Shuttle Main Engine – R.J. DOMINIC, University of Dayton Research Institute, Dayton, OH

6. USS Long Beach (CGN9) 2500 KWTG Set Curtis Stage 1-A Failure Analysis – P.D. SAUNDERS, Westinghouse Electric Corp., Marine Division, Sunnyvale, CA

Session 5A **Thursday, October 20**
2:00 p.m. **Wentworth Room**

VIBRATION PROBLEMS

Chairman: Mr. Brantley Hanks, NASA Langley Research Center, Hampton, VA

Cochairman: Dr. Robert S. Reed, Naval Surface Weapons Center, Silver Spring, MD

1. Vibrational Loading Mechanism of Unitized Corrugated Containers with Cushions and Nonload-Bearing Contents – T.J. URBANIK, USDA Forest Service, Forest Products Laboratory, Madison, WI

2. Leakage-Flow Induced Vibrations of a Chimney Structure Suspended in a Liquid Flow -- H. CHUNG, Argonne National Laboratory, Argonne, IL

3. The Experimental Performance of an Off-Road Motorcycle Utilizing a Semi-Active Suspension – E.J. KRASNICKI, Lord Corporation, Erie, PA

4. A Theoretical and Experimental Analysis of a Multilayered Active Vibration Isolation Mount – J.G. VILLARREAL, Massachusetts Institute of Technology, Cambridge, MA

5. Application of the Random Decrement Technique for Determining the Hydrodynamic Damping of Circular Cylinders – J. JIANG, D. CHEN, J.C.S. YANG, C.H. MARKS, and W.H. TSIA, Maryland University, College Park, MD

6. Testing of the F-15 for Ground Roughness Induced Structural Response – I. ZVOLANEK, McDonnell Aircraft Co., St. Louis, MO

7. Effect of Air Cavity on the Vibration Analysis of Loaded Circular and Annular Drums – S. DE, U.G.C., New Delhi, India

Session 5B **Thursday, October 20**
2:00 p.m. **Georgian Room**

SHORT DISCUSSION TOPICS

Chairman: Mr. Howard Camp, Jr., U.S. Army Electronic Research Development Command, Ft. Monmouth, NJ

Cochairman: Mr. E. Kenneth Stewart, U.S. Army Armament R&D Command, Picatinny Arsenal, Dover, NJ

Details of this session will appear in the final program.

Technical Tour **Friday, October 21**
9:00 a.m. ***Depart Huntington Sheraton Hotel***
1:00 p.m. **Return Huntington Sheraton Hotel**

The tour of the Jet Propulsion Laboratory in Pasadena will relate to activities other than the normal shock and vibration. The tour will be of general interest connected to JPL's DOD-related activities. The tour will be of JPL's Space Activity Center, *which will include films of Jupiter. We will see* JPL's satellite tracking facilities and their bio-medical facilities.

ABSTRACT CATEGORIES

MECHANICAL SYSTEMS

Rotating Machines
Reciprocating Machines
Power Transmission Systems
Metal Working and Forming
Isolation and Absorption
Electromechanical Systems
Optical Systems
Materials Handling Equipment

STRUCTURAL SYSTEMS

Bridges
Buildings
Towers
Foundations
Underground Structures
Harbors and Dams
Roads and Tracks
Construction Equipment
Pressure Vessels
Power Plants
Off-shore Structures

VEHICLE SYSTEMS

Ground Vehicles
Ships
Aircraft
Missiles and Spacecraft

BIOLOGICAL SYSTEMS

Human
Animal

MECHANICAL COMPONENTS

…sorbers and Isolators
Springs
Tires and Wheels
Blades
Bearings
Belts
Gears
Clutches
Couplings
Fasteners
Linkages
Valves
Seals
Cams

STRUCTURAL COMPONENTS

Strings and Ropes
Cables
Bars and Rods
Beams
Cylinders
Columns
Frames and Arches
Membranes, Films, and Webs
Panels
Plates
Shells
Rings
Pipes and Tubes
Ducts
Building Components

ELECTRIC COMPONENTS

Controls (Switches, Circuit Breakers)
Motors
Generators
Transformers
Relays
Electronic Components

DYNAMIC ENVIRONMENT

Acoustic Excitation
Shock Excitation
Vibration Excitation
Thermal Excitation

MECHANICAL PROPERTIES

Damping
Fatigue
Elasticity and Plasticity
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ABSTRACT CONTENTS

MECHANICAL SYSTEMS

ROTATING MACHINES

(Also see Nos. 1751, 1756, 1785, 1786, 1796, 1890, 1902)

83-1696

Rotor Response and Sensitivity

J.C. Wachel

Engineering Dynamics Inc., San Antonio, TX, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 1-12, 16 figs, 12 refs

Key Words: Rotors, Critical speeds, Parametric response, Unbalanced mass response

Rotor response calculations are used to define peak response critical speeds and thus are a vital part of purchase specifications. To accurately calculate the range of critical speeds the rotordynamic analyses should consider all the variables that influence rotor response. These include bearing clearance, preload and oil temperatures and other parameters such as unbelance location and amplitude. The sensitivity of rotor response calculations to parametric changes in these variables is discussed in this paper. Procedures that are used to improve correlation between field measured data and rotor response calculations are reviewed and some general conclusions are presented.

83-1697

An Experimental Investigation on Torsional Oscillations in Constant Velocity Two-Cardan-Joint Drives

A. Costa and P. Davoli

Dept. of Mechanics, Politecnico di Milano, Meccanica, 18 (1), pp 34-53 (Mar 1983) 24 figs, 1 table, 5 refs

Key Words: Rotors, Cardan shafts, Torsional vibration, Self-excited vibrations, Experimental test data

The paper reports experimental results from a series of systematic tests carried out by means of a specially built testing apparatus, and aimed at verifying stability conditions for self-excited torsional oscillations in constant-velocity two-Cardan-joint drives.

83-1698

Vibration Analysis of Radial Compressor Impellers

J. Wachter and H. Celikbudak

Univ. of Stuttgart, Germany, ASME Paper No. 83-GT-156

Key Words: Vibration analysis, Impellers, Compressors, Turbomachinery, Natural frequencies, Mode shapes ·

The results of this study show that the finite element method can be used to predict natural frequencies and mode shapes of impellers of radial turbomachines. This technique is particularly applicable during the design of a new impeller.

83-1699

Experiences in Commissioning a 22 MW Turbine Generator -- Coupling Unbalance, Oil Whirl, and Secondary Resonance

C. Jackson

Monsanto Co., Texas City, TX, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 155-176, 14 figs

Key Words: Turbogenerators, Balancing techniques, Alignment, Oil whirl phenomena

This paper covers the commissioning of a 22 megawatt steam turbine/gear driven electrical generator. The turbine is a 62 bar (≈ 900 psig), 11 bar passout (160 psig extraction) and 3 bar (45 psig) back pressure exhaust driving thru a 3.67 ratio single helical reducer to a four pole alternator at 21 ton weight and operating at 1500 rpm. The primary purpose is to expose some factors; i.e., in place halancing by coupling reposition, alignment tips, and certain bearing alterations to remove pure oil whirl instabilities. Many design factors can be based on constructive instrumentation data.

83-1700

The Effect of Internal Damping on the Stability of Laval Shaft in Anisotropic Elastic Bearings (Zur Stabilitat der Laval-Welle in anisotrop elastischen Lagern unter Berücksichtigung innerer Dämpfung)

L. Forrai

Technische Hochschule Miskolc, Ungarische VR, Maschinenbautechnik, 32 (2), pp 80-85 (Feb 1983) 8 figs, 7 refs

(In German)

Key Words: Rotating machinery, Stability, Damping effects, Anisotropy

In high speed rotating machinery an accurate knowledge of the effects of vibration on the operational stability is of utmost importance. In the paper operating stability limits for a Laval-shaft are determined by means of a method from control theory, called the Method of Parameter Conditions. It enables to find a closed solution for the stability limits by means of characteristic equations up to the 6th order. It is shown that the limiting curves of the instability region for certain Laval shaft parameter combinations produce contradictory results and, in a special case, the limiting curve is independent of bearing anisotropy.

83-1701

Some Analysis Methods for Rotating Systems with Periodic Coefficients

J. Dugundji and J.H. Wendell

Massachusetts Inst. of Tech., Cambridge, MA, AIAA J., 21 (6), pp 890-897 (June 1983) 32 refs

Key Words: Rotating structures, Wind turbines, Helicopters, Floquet theory, Harmonic balance method

This paper reviews two of the more common procedures for analyzing the stability and forced response of equations with periodic coefficients; namely, the use of Floquet methods and the use of multiblade coordinate and harmonic balance methods. The use of rotating coordinates and perturbation methods is also briefly discussed. The analysis procedures of these periodic coefficient systems are compared with those of the more familiar constant coefficient systems.

83-1702

Turbofan Noise Generation. Volume 1: Analysis

C.S. Ventres, M.A. Theobald, and W.D. Mark

Bolt Beranek and Newman, Inc., Cambridge, MA, Rept. No. REPT-4770, NASA-CR-167952, 123 pp (July 1982)

N83-15041

Key Words: Turbofans, Blades, Noise generation, Compute programs

Computer programs are developed which calculate the in-duct acoustic modes excited by a fan/stator stage operating at subsonic tip speed. Three noise source mechanisms are included: sound generated by the rotor blades interacting with turbulence ingested into, or generated within, the inlet duct; sound generated by the stator vanes interacting with the turbulent wakes of the rotor blades; and sound generated by the stator vanes interacting with the mean velocity deficit wakes of the rotor blades.

83-1703

Torsional System Damping

A.J. Smalley

Southwest Research Inst., San Antonio, TX, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 23-30, 16 figs, 2 refs

Key Words: Compressors, Torsional vibration, Damping effects

One of the uncertainties in torsional analysis of compressor trains is the damping to be expected during steady state and transient response. In this paper torsional system damping data inferred from a number of field investigations is presented. Analytical results are also presented which investigate the contribution to system damping of dynamic lateral displacement and dissipation in gearbox bearings, local torsional damping in a dissipative coupling if present in the system, and load damping. Comparisons are made between the values obtained in these studies and the ranges of values recommended in the literature and used in the industry.

83-1704

Diffuser Type Pump Vibration Resulting from Impeller/Diffuser Vane Force Interaction

T.I. Moore

Radian Corp., Austin, TX, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 13-21, 12 figs, 1 ref

Key Words: Pumps, Vibration analysis

High casing vibration levels were found on four stage diffuser type barrel water injection pumps. The generating mechanism for the predominant vibration frequency of 14 and 28 times running speed, in a diffuser pump with 7 impeller vanes and 13 diffusers, was not readily apparent upon first inspection. Through a detailed analysis of vane interaction forces, the 14 and 28 times running speed vibration was explained. A few hypothetical pumps are studied with variations in the number of impeller and diffuser vanes, the angle between pump stages, and the frequency content in the pressure pulsation/vane forcing function.

RECIPROCATING MACHINES

83-1705

Case Histories on Steam Turbine Driven Low Speed Reciprocating Compressors

T.J. Finneran

Ingersoll-Rand Co., Painted Post, NY, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 181-186, 4 figs, 2 tables

Key Words: Compressors, Reciprocating compressors, Torsional vibration, Case histories

This paper describes three cases of torsional vibration problems encountered on steam turbine driven low speed reciprocating compressors and the resolutions of these problems. It concludes with recommendations on similar applications to preclude similar problems.

POWER TRANSMISSION SYSTEMS

83-1706

The Effect of Dynamic Loads and Wear of Drives on the Start-up of Hydrostatic Drives of Construction Equipment (Die Wirkung dynamischer Belastungen und des Getriebeverschleisses auf das Anlaufverhalten hydrostatischer Fahrantriebe von Baumaschinen)

M. Schuszter and V.T. Binh

Hochschule f. Verkehrswesen „Friedrich List" Dresden, German Dem. Rep., Hebezeuge und Fördermittel, 23 (1), pp 16-19 (1983) 8 figs, 4 refs

(In German)

Key Words: Mechanical drives, Wear, Start-up response, Design techniques

A mathematical model is presented which includes the effect of dynamic loads and the wear of mechanical drives on the dynamic response of hydraulic drives. The necessary design parameters for a hydraulic minicar are found, reducing the start-up excitation.

METAL WORKING AND FORMING

83-1707

The Grinding Wheel as a Transmitter of Regenerative Chatter (Die Schleifscheibe als Träger des regenerativen Ratterns)

W. König and H. Föllinger

Industrie Anzeiger, 105 (30), pp 47-50 (Apr 15, 1983) 5 figs, 20 refs

(In German)

Key Words: Machine tools, Chatter, Grinding, Grinding machinery

In polishing processes, as opposed to the machining with geometrically defined cutting, the machine tool also can be the transmitter of regenerative chatter. It is caused by the macrogeometrical waviness of wheel circumference. At first, zones of variable sharpness occur periodically in the cutting area. Conventional polishi.. wheels, depending on their specifications, are more or less inclined to building such zones. The microwaviness of hard and fine grained wheels increases with polishing time. They cause a cutting force modulation, which leads to a regenerative chatter, without any contribution from the relevant macrogeometric waviness.

83-1708

Vibration Phenomena in Truing and Grinding Operations (Schwingungsphenomäne beim Abricht- und Schleifprocess)

M. Weck and N. Klotz

Industrie Anzeiger, 105 (30), pp 50-54 (Apr 15, 1983) 9 figs, 6 refs

(In German)

Key Words: Machine tools, Vibration control, Grinding machinery

Machine tool flexibility during grinding causes displacements between the polishing wheel and the blank. These displacements cause undesirable waviness or markings on the blank. Since in many cases the polishing wheel is the reason for the development of waviness, truing – which determines the basic shape and the topography of the polishing wheel -- is very important in the polishing process. Vibrations occuring between the dressing tool and the polishing wheel during truing cause waviness in the wheel. Such wheels cause vibrations during polishing and thus accelerate the instability of the process. The article discusses the dynamics of the truing and polishing processes and presents two case histories where such vibrations were corrected.

83-1709

Dynamic Cutting Process Identification by Dynamic Data System (DDS) Models

T.Y. Ahn

Ph.D. Thesis, The Univ. of Wisconsin-Madison, 304 pp (1982)
DA8301848

Key Words: Cutting

Anticipating the stochastic nature of the cutting process and the double modulation principle, Dynamic Data System methodology was employed for the dynamic cutting process identification model. Modified autoregressive moving average vector (MARMAV) modeling approach was chosen for the determination of the dynamic cutting process model. Transfer function of the dynamic cutting processes in the form of the dynamic cutting force coefficients were obtained from the MARMAV models. For the determination of the dynamic cutting force coefficients, two different methods were proposed according to the input conditions of the cutting process.

83-1710

Pulse Excitation Technique for Determining Frequency Response of Machine Tools Using an On-Line Mini Computer and a Non-Contacting Electromagnetic Exciter

M. Yuce, M.M. Sadek, and S.A. Tobias
Dept. of Mech. Engrg., Univ. of Birmingham, P.O. Box 363, Birmingham B5 2TT, UK, Intl. J. Mach. Tool Des. Res., 23 (1), pp 39-51 (1983) 13 figs, 1 table, 12 refs

Key Words: Machine tools, Frequency response, Pulse excitation

An electromagnetic pulse excitation technique for the determination of receptance data is presented. The relative performance of this in relation to the conventional stepped and swept sine methods was established in tests carried out on a horizontal milling machine. Good correspondence between the three techniques was noted, thus confirming the reliability of the electromagnetic pulse technique. The pulse excitation technique was then used for determining the relative response data of a cylindrical grinding machine.

83-1711

Chatter Vibration of Lathe Tools. Part 1: General Characteristics of Chatter Vibration

E. Marui, S. Ema, and S. Kato
Gifu Univ., 1-1 Yanagido, Gifu-shi, 501-11, Japan, J. Engrg. Indus., Trans. ASME, 105 (2), pp 100-106 (May 1983) 19 figs, 8 refs

Key Words: Machine tools, Lathes, Chatter

The primary chatter vibration of turning tools is investigated experimentally. The vertical displacement of the turning tool and the fluctuating cutting force in the primary chatter vibration are measured simultaneously to investigate the characteristics and the resulting vibration mechanism when cutting the top of a square thread of mild steel or cast iron.

83-1712

Chatter Vibration of Lathe Tools. Part 2: On the Mechanism of Exciting Energy Supply

E. Marui, S. Ema, and S. Kato
Gifu Univ., 1-1 Yanagido, Gifu-shi, 501-11, Japan, J. Engrg. Indus., Trans. ASME, 105 (2), pp 107-113 (May 1983) 20 figs, 5 refs

Key Words: Machine tools, Lathes, Chatter

The development of the chatter vibration is observed using several turning tools having various cutting edge configurations and in the conditions in which there are different levels of interference between the flank of the tool and the workpiece. The exciting energy provided by the contact of tool flank and workpiece is calculated using an interference model at the tool flank which includes an elastic deformation of workpiece. This theoretical result agrees qualitatively with the experimental result concerning the development of chatter vibration.

STRUCTURAL SYSTEMS

BRIDGES

83-1713

Modal Methods in Continuous Bridge Deck Statics

A.G. Zechini
Intermetro S.p.a. (General Contractor for Rome's Underground Railways), 55, via tor Fiorenza, Rome,

Italy 00199, ASCE J. Struc. Engrg., 109 (6), pp 1507-1517 (June 1983) 5 figs, 2 tables, 7 refs

Key Words: Bridges, Modal analysis

The growing use of continuous bridge decks as a structural type has demanded more sophisticated analytical methods to investigate static behavior under live loads. These methods are based, essentially for the beam-and-slab decks, on the analysis of computer aided equivalent grillages. Solutions in close form are not available since harmonic analysis is sound only for simply supported bridge decks. If a differential equation system describing deck behavior is studied by modal analysis techniques it is possible, in two limiting cases, to give a solution in close form made up of a set of uncoupled differential equations for a set of independent beams on elastic foundation.

BUILDINGS

(Also see Nos. 1849, 1850)

83-1714

Response of Sliding Structures to Harmonic Support Motion

N. Mostaghel, M. Hejazi, and J. Tanbakuchi

Dept. of Civil Engrg., The Univ. of Utah, Salt Lake City, UT, Intl. J. Earthquake Engrg. Struc. Dynam., 11 (3), pp 355-366 (May/June 1983) 9 figs, 15 refs

Key Words: Buildings, Seismic design, Seismic isolation, Sliding supports

The problem of response of a single degree of freedom structure supported on a sliding foundation and subjected to harmonic support motions is considered. The nonlinear governing equations of motion are derived. These equations are linear in each sliding and nonsliding phase and can be solved in closed forms in each phase. The equations for evaluation of the beginning and ending times of different phases are also formulated and solved numerically. The response for different coefficients of friction and various levels of excitation is evaluated and presented graphically.

83-1715

Building over Faults: A Procedure for Evaluating Risk

J.B. Berrill

Dept. of Civil Engrg., Univ. of Canterbury, Christchurch, New Zealand, Intl. J. Earthquake Engrg. Struc. Dynam., 11 (3), pp 427-436 (May/June 1983) 6 figs, 11 refs

Key Words: Buildings, Seismic design, Damage prediction

This paper examines the risk from fault offset to a building constructed over the surface trace of a fault. An expression relating the magnitude of surface offset to its return period is derived using classical seismic hazard analysis. The risk from fault offset is compared with that due to ground shaking by comparing offsets and MM intensities with equal likelihoods of occurrence.

83-1716

Upgrading Seismic Resistance of Buildings for Moderate Earthquake Risk

F. Knoll

Nicolet Chartrand Knoll and Associates Ltd., 620 Dorchester Blvd. West, Suite 400, Montreal, Canada H3B 1N7, Engrg. Struc., 5 (2), pp 133-140 (Apr 1983) 12 figs, 6 refs

Key Words: Buildings, Seismic response

Three examples of buildings are presented which, in the course of renovation and extension, were upgraded for seismic resistance. Qualitative principles for improvement of seismic performance are established for use in cases where exact methods of analysis and design are not applicable. Applications for zones of moderate seismicity are discussed.

83-1717

Damping in Building Structures During Earthquakes: Test Data and Modeling

D.W. Coats, Jr.

Ph.D. Thesis, Univ. of California, 259 pp (1982) DA8304748

Key Words: Buildings, Seismic response, Damping effects

A review and evaluation of the state-of-the-art of damping in building structures during earthquakes is presented. The primary emphasis is in the following areas: the evaluation of commonly used mathematical techniques for incorporating damping effects in both simple and complex systems; a compilation and interpretation of damping test data; and an evaluation of structure testing methods, building instrumentation practices, and an investigation of rigid-body rotation effects on damping values from test data.

83-1718
Infills in Seismic Resistant Building
V. Bertero and S. Brokken
Univ. of California, Berkeley, CA, ASCE J. Struc. Engrg., 109 (6), pp 1337-1361 (June 1983) 11 figs, 6 tables, 10 refs

Key Words: Buildings, Reinforced concrete, Seismic design

This paper summarizes studies in which the effects of masonry and lightweight concrete infills on R/C moment existing frame buildings were studied experimentally and analytically. The experimental investigation consisted of a series of quasi-static cyclic and monotonic load tests on 1/3-scale models of the lower 3-1/2 stories of an 11 story three-bay reinforced concrete frame infilled in the outer two bays. Different panel material and reinforcement combinations were tested.

83-1719
Evaluation of the Design and Analytical Seismic Response of a Seven-Story Reinforced Concrete Frame-Wall Structure
F.A. Charney and V.V. Bertero
Earthquake Engrg. Res. Ctr., California Univ., Berkeley, CA, Rept. No. NSF/CEE-82064, 199 pp (Aug 1982)
PB83-157628

Key Words: Buildings, Reinforced concrete, Multistory buildings, Seismic response

This report describes analytical studies regarding the response of a reinforced concrete test building which has been subjected to earthquake induced loading. The elastic properties of the structure are investigated through the use of flexibility matrices; the inelastic response of the structure to monotonically increasing lateral loads is studied; and a nonlinear dynamic analysis using the computer program DRAIN-2D, which indicates that the response of the test building to different recorded ground motions is governed by the behavior of the centrally located shearwall, is presented.

83-1720
Dynamic Response Analysis of Elevator Model
T.Y. Yang, H. Kullegowda, R.K. Kapania, and A.J. Schiff
School of Aeronautics and Astronautics, Purdue Univ., West Lafayette, IN, ASCE J. Struc. Engrg., 109 (5), pp 1194-1210 (May 1983) 18 figs, 2 tables, 9 refs

Key Words: Elevators, Seismic response

Time history response of an elevator rail and counterweight model is studied using numerical and experimental methods. Beam finite elements are used to model the rail and the counterweight. In addition to the development of simple models and the use of Guyan reduction method, two techniques are introduced to reduce computing time.

TOWERS

83-1721
Seismic Analysis of Intake Towers
P.F. Mlaker and P.S. Jones
Structures Lab., Army Engineer Waterways Experiment Station, Vicksburg, MS, Rept. No. WES/TR/SL-82-8, 60 pp (Oct 1982)
AD-A123 578

Key Words: Towers, Seismic analysis

Practical analytical methods for evaluating the seismic safety of intake towers are discussed. Methods of various degrees of sophistication and conservatism are examined which approximately consider linear structural dynamic behavior and site-specific earthquake motion. The need for further research to incorporate other considerations is explained.

FOUNDATIONS

83-1722
On the Effect of the Rigid Sidewall on the Dynamic Stiffness of Embedded Circular Footings
J.L. Tassoulas and E. Kausel
Dept. of Civil Engrg., The Univ. of Texas, Austin, TX 78712, Intl. J. Earthquake Engrg. Struc. Dynam., 11 (3), pp 403-414 (May/June 1983) 11 figs, 6 refs

Key Words: Footings, Dynamic stiffness, Damping coefficients

The effect of the rigid sidewall, which is usually combined with embedded footings, on the dynamic stiffness of the

footings is considered. An efficient numerical technique is used to calculate the static and dynamic stiffness of circular footings embedded in a stratum. The results show that the increase in static stiffness with increasing height of the sidewall is most significant in the case of rocking.

HARBORS AND DAMS

83-1723
Air Demand and Vibration Measurements, Wynoochee Dam, Wynoochee River, Washington
E.D. Hart
Hydraulics Lab., Army Engineer Waterways Experiment Station, Vicksburg, MS, Rept. No. WES/TR/HL-82-2, 50 pp (Dec 1982)
AD-A123 915

Key Words: Dams, Vibration measurement

Tests were conducted to determine: the magnitude of vibrations occurring at the dam structure, Vista House, and sluice gate; gate-lip pressure fluctuations; airflow rates; and if correlation existed between the gate and Vista House vibrations.

83-1724
In Situ Seismic Investigation of Black Butte Dam
J.L. Llopis and R.E. Wahl
Geotechnical Lab., Army Engineer Waterways Experiment Station, Vicksburg, MS, Rept. No. WES/MP/GL-82-18, 84 pp (Dec 1982)
AD-A123 949

Key Words: Dams, Seismic analysis

Surface refraction, surface vibratory, downhole, and crosshole seismic tests were conducted. Compression-, shear-, and Rayleigh-wave (P-, S-, R-wave) velocities as a function of depth were determined for the dam and underlying foundation materials.

CONSTRUCTION EQUIPMENT

(See No. 1729)

POWER PLANTS

83-1725
Experimental Verification of a Vessel Dynamic Design Computation Validation (Experimentale d'un Calcul Dynamique de Reservoir)
M. Bonnefroy
Centre Technique des Industries Mecaniques, Senlis, France, Rept. No. CETIM-11-E-322, 108 pp (May 15, 1982)
N83-14550
(In French)

Key Words: Fluid-filled containers, Seismic response, Experimental test data, Nuclear power plants

An experimental study to verify the dynamic and seismic load finite element method computation carried out in designing an oil containing vessel for a nuclear plant is presented. The location of the accelerometers and the experimental procedure is described. The frequencies of the two vessel modes susceptible to seismic excitation are correctly obtained either by the theoretical computation or by experimental means.

OFF-SHORE STRUCTURES

(Also see No. 1795)

83-1726
Effect of Radiation Damping on Earthquake Response of Pile-Supported Offshore Platforms
T. Nogami, I.M. Idriss, M.S. Power, and C.-Y. Chang
Univ. of Houston, Houston, TX, Intl. J. Earthquake Engrg. Struc. Dynam., 11 (3), pp 337-353 (May/June 1983) 17 figs, 1 table, 12 refs

Key Words: Off-shore structures, Drilling platforms, Seismic design, Seismic response

An economical approach was developed to examine the effect of radiation damping on earthquake response of pile-supported offshore platfor s. Parametric studies were conducted to evaluate the effe ts of radiation damping on response. Various features of this effect were found for pile head stiffnesses and responses of platforms subjected to harmonic and earthquake excitations.

83-1727
Stochastic Response of Prototype Offshore Structure
M.G. Grecco and R.T. Hudspeth
Union Oil Co., Brea, CA 92621, ASCE J. Struc. Engrg., 109 (5), pp 1119-1138 (May 1983) 6 figs, 4 tables, 20 refs

Key Words: Drilling platforms, Off-shore structures, Stochastic processes, Frequency domain method

The dynamic responses of a prototype space-frame offshore structure to both measured and simulated stochastic wave forces are evaluated. A linearized, nondeterministic frequency domain analysis is made on a two-dimensional model of a prototype offshore production platform.

VEHICLE SYSTEMS

GROUND VEHICLES

(Also see Nos. 1753, 1758, 1765, 1766, 1878)

83-1728
Lateral Dynamics of Commercial Vehicle Combinations -- A Literature Survey
F. Vlk
Dept. of Automobile Engrg., Technical Univ. of Brno, CS-602 00 Brno, Czechoslovakia, Vehicle Syst. Dynam., 11 (5-6), pp 305-324 (Dec 1982) 2 figs, 3 tables, 254 refs

Key Words: Articulated vehicles, Ride dynamics, Reviews

A review of theoretical and experimental works relative to the handling performance of commercial vehicle combinations is presented. A commercial vehicle combination (road train) is defined as a tractor unit and an arbitrary number of trailers. The review contains literature corresponding the most widely used types of trains: tractor-semitrailer, truck-trailer and tractor-semitrailer-semitrailer (doubles).

83-1729
Directional Dynamics of a Tractor-Loader-Backhoe
R.H. Owen and J.E. Bernard
Vehicle Syst. Dynam., 11 (5-6), pp 251-265 (Dec 1982) 11 figs, 19 refs

Key Words: Tractors, Ride dynamics, Tires

This paper presents a study of the directional dynamics of large industrial tractors. These vehicles have special properties which make their dynamics interesting, including soft rear tires, large yaw moments of inertia and low or negative understeer gradients.

83-1730
Dynamic Performance of Single-Axle Freight Trucks
D.N. Wormley and P.A. Tombers
Massachusetts Inst. of Tech., Cambridge, MA, J. Engrg. Indus., Trans. ASME, 105 (2), pp 71-74 (May 1983) 10 figs, 2 tables, 2 refs

Key Words: Trucks, Freight cars, Stability, Interaction: rail-wheel, Suspension systems (vehicles)

An analysis has been developed to evaluate the stability of freight cars employing single-axle freight trucks. The analysis has been used to evaluate the influence of wheel/track contact geometry, suspension stiffness, and loading on truck stability.

83-1731
Spectral Analysis of Freight Car Truck Lateral Response in Dynamically Scaled Model Experiments
L.M. Sweet and A. Karmel
Dept. of Mech. and Aerospace Engrg., Princeton Univ., NJ, Rept. No. 1586-MAE, DOT-RSPA-DMA-50-82/14, 5 pp (Sept 3, 1982)
PB83-139436

Key Words: Spectrum analysis, Freight cars, Railroad cars, Interaction: rail-vehicle

This report summarizes methods used to quantify the lateral response of freight car trucks to random track irregularity inputs. Spectral analysis is applied to the results of an extensive series of experiments using a one-fifth scale model of a truck and half carbody, in which all inertial, friction, creep, and stiffness forces are dynamically scaled.

83-1732

Analysis of Locomotive Cabs

National Space Tech. Labs., NSTL Station, MS, Rept. No. DOT/FRA/ORD-81/84, 170 pp (Sept 1982)
PB83-150631

Key Words: Collision research (railroad), Locomotives

This report covers research that was performed to investigate the present crashworthiness state of in-service locomotives and design applications for new locomotives to protect occupants from serious or fatal injury during collision conditions.

83-1733

Effect of Kinematic Oscillation on Tractive Characteristics of Steel Wheel on Rail

S. Kumar, J.S. Kim, D.L. Prasanna Rao, and L. Qian
Illinois Inst. of Tech., Chicago, IL 60616, J. Engrg. Indus., Trans. ASME, 105 (2), pp 61-63 (May 1983) 5 figs, 9 refs

Key Words: Interaction: rail-wheel, Experimental test data

The effect of kinematic oscillation of a wheel on a rail has been experimentally investigated. It has been found that unlike the decrease of longitudinal adhesion observed in curve negotiation with a steady angle of attack, the kinematic oscillation at a small oscillation angle seems to actually increase the maximum adhesion levels that can be achieved. This implies that the wheel conicity is slightly beneficial from the point of view of the levels of adhesion that may be achieved.

83-1734

Experimental Investigation of Contact Stresses Between a U.S. Locomotive Wheel and Rail

S. Kumar, Y.S. Adenwala, and B.R. Rajkumar
Illinois Inst. of Tech., Chicago, IL 60616, J. Engrg. Indus., Trans. ASME, 105 (2), pp 64-70 (May 1983) 8 figs, 1 table, 16 refs

Key Words: Interaction: rail-wheel, Experimental test data

An experimental study of the real contact stresses for U.S. locomotives and rails including the effects of plasticity and wear has been performed under laboratory Hertzian simulation. Experiments were performed under both traction and braking conditions to account for differences observed earlier in the two modes. Wheel/rail tests were conducted using adhesion coefficients of 0.02, 0.15, and 0.25. Average contact stresses for various stages of wear were determined by measuring the contact areas.

SHIPS

83-1735

An Introduction to Ship Hydroelasticity

R.E.D. Bishop and W.G. Price
Dept. of Mech. Engrg., University College London, London WC1 7JE, UK, J. Sound Vib., 87 (3), pp 391-407 (Apr 8, 1983) 12 figs, 1 table, 11 refs

Key Words: Ships, Wave forces, Beams, Periodic excitation

The linear theory of ship hydroelasticity is not yet familiar in naval architecture, yet it provides the most powerful techniques of investigation available today. The background of that theory is explained in very simple terms, by using the concept of a uniform ship; that is, of a uniform floating beam. So rudimentary is this idealization of a ship that no claim can be made that numerical results have much practical significance; nevertheless, the underlying ideas are those employed in practical studies and some typical results are given for an actual ship.

AIRCRAFT

(Also see Nos. 1779, 1797, 1799, 1816, 1923, 1924)

83-1736

The Response of Aircraft to Pulse Excitation

P.K.R. Bhargov and H.R. Srirangarajan
Structures and Materials Div., Aeronautical Development Establishment, Jeevan Bhima Nagar, Bangalore-560075, India, Computers Struc., 17 (3), pp 335-338 (1983) 5 figs, 2 refs

Key Words: Aircraft, Pulse excitation, Two degree of freedom systems

Response of aircraft, idealized as a two degree of freedom system, to pulse excitation is obtained using Runge Kutta algorithm on a micro computer MICRO 2200. The procedure is illustrated with a numerical example.

83-1737
Military Aircraft Noise
P.A. Shahady
Air Force Aero Propulsion Lab., Wright-Patterson AFB, OH, 6 pp (June 1982), AD-P000 322

Key Words: Aircraft noise, Noise reduction

Opportunities to reduce military aircraft noise without inhibiting mission capability are considered. Emphasis is placed on the need for a comprehensive military aircraft noise abatement program involving compatible land use in the vicinity of military airports, operational constraints, and procedures to reduce noise impact and source noise reduction. The military to civil transfer of aircraft and engine technology is discussed together with the effect of increasing civil noise constraints on this evolutionary practice.

83-1738
Aircraft Turbofan Noise
J.F. Groeneweg and E.J. Rice
NASA Lewis Res. Ctr., Cleveland, OH, ASME Paper No. 83-GT-197

Key Words: Aircraft noise, Fan noise, Turbofan engines, Noise generation, Noise reduction

Recent advances in the understanding of turbofan noise generation and suppression in aircraft engines are reviewed with particular emphasis on NASA research. The review addresses each link in the chain of physical processes which connect unsteady flow interactions with fan blades to far field noise.

83-1739
Shock-Associated Noise in Supersonic Jets
S.P. Pao and J.M. Seiner
NASA Langley Res. Ctr., Hampton, VA, AIAA J., 21 (5), pp 687-693 (May 1983) 12 figs, 8 refs

Key Words: Aircraft noise, Jet noise, Noise generation, Supersonic aircraft

This paper examines the fundamental mechanism of broadband shock noise in an improperly expanded supersonic jet. The study includes circular convergent and convergent-divergent nozzles. The main source of shock noise is determined to be the transient interaction between the shock front and the convected vorticity within the jet plume. The discussion of the noise generation mechanism is based on detailed numerical analysis, theoretical modeling, refined measurements of the jet mean flow, shock-cell structure, turbulence, and noise. Results in this study provide a broad-based generalization for the Harper-Bourne and Fisher analysis and prediction method.

83-1740
Time-of-Day Corrections in Measures of Aircraft Noise Exposure
R.B. Bullen and A.J. Hede
Natl. Acoustic Labs., 5 Hickson Rd., Millers Point, NSW 2000, Australia, J. Acoust. Soc. Amer., 73 (5), pp 1624-1630 (May 1983) 4 tables, 13 refs

Key Words: Aircraft noise, Noise measurement, Human response

Results of a socio-acoustic study of human reaction to aircraft noise around Australian airports are described. The relative importance of night, evening, and daytime operations in determining overall reaction is assessed using a correlation analysis procedure.

83-1741
Heavy-Lift Airship Dynamics
M.B. Tischler, R.F. Ringland, and H.R. Jex
Systems Technology, Inc., Hawthorne, CA, J. Aircraft, 20 (5), pp 425-433 (May 1983) 8 figs, 2 tables, 22 refs

Key Words: Aircraft, Aerodynamic characteristics

A nonlinear, multibody, 6-degrees-of-freedom digital simulation has been developed to study generic heavy-lift airship (HLA) dynamics and control. The slung-payload and flight control system models are described, and a review of the aerodynamic characteristics of an example vehicle is presented. Trim calculations show the importance of control mixing selection, and suggest performance deficiencies in crosswind stationkeeping for the unloaded example HLA.

83-1742
Analytical Procedures for Flutter Model Development and Checkout in Preparation for Wind Tunnel Testing of the DAST ARW-1 Wing
S. Pines

Analytical Mechanics Associates, Inc., Hampton, VA, Rept. No. AMA82-35, NASA-CR-166023, 87 pp (Dec 1982)
N83-15317

Key Words: Aircraft wings, Flutter, Aerodynamic characteristics

A study to develop analytical procedures to be used in the checkout and calibration of a flutter wind tunnel model of the DAST ARW-1 wing equipped with a flutter suppression device is reported. The methods used to obtain a realistic simulation of the structural inertial and aerodynamic properties of the wing, the hydro-electro-servo actuator used for flutter suppression, a prediction of the open loop flutter speed at a fixed Mach number (.897), a procedure for checkout and calibration using the method frequency response of a wing mounted accelerometer, and an analytical representation of a reduced state approximation of the overall system are described.

83-1743

Correlation and Assessment of Structural Airplane Crash Data with Flight Parameters at Impact

H.D. Carden

NASA Langley Res. Ctr., Hampton, VA, Rept. No. L-15431, NASA-TP-2083, 44 pp (Nov 1982)
N83-14521

Key Words: Crash research (aircraft)

Crash deceleration pulse data from a crash dynamics program on general aviation airplanes and from transport crash data were analyzed. Structural airplane crash data and flight parameters at impact were correlated. Uncoupled equations for the normal and longitudinal floor impulses in the cabin area of the airplane were derived, and analytical expressions for structural crushing during impact and horizontal slide out were also determined.

83-1744

Design, Development, and Fabrication of a Crash Sensor for Military Helicopters

R.W. Diller

Technar, Inc., Arcadia, CA, Rept. No. NADC-81310-60, 47 pp (Nov 19, 1981)
AD-A123 422

Key Words: Crash research (aircraft), Helicopters, Air bags (safety restraint systems)

This effort resulted in the design and construction of a crash sensing system for military helicopters to be used to electrically detonate the squibs of an inflatable body and head restraint system during a crash. Calibration sensitivity levels were established through computer simulations using acceleration data collected in previous helicopter crash tests.

83-1745

Identification and Stochastic Control of Helicopter Dynamic Modes

J.A. Molusis and Y. Barshalom

Univ. of Connecticut, Storrs, CT, Rept. No. NASA-CR-166425, 73 pp (Jan 1983)
N83-15283

Key Words: Helicopters, Parameter identification technique, Stochastic processes

A general treatment of parameter identification and stochastic control for use on helicopter dynamic systems is presented. Rotor dynamic models, including specific applications to rotor blade flapping and the helicopter ground resonance problem, are emphasized. Dynamic systems which are governed by periodic coefficients as well as constant coefficient models are addressed.

83-1746

Response Studies of Rotors and Rotor Blades with Application to Aeroelastic Tailoring

P.P. Freidmann

Dept. of Mechanics and Structures, Univ. of California, Los Angeles, CA, Rept. No. NASA-CR-169740, 17 pp (Dec 1982)
N83-15267

Key Words: Helicopters, Propeller blades, Vibration control

Various tools for the aeroelastic stability and response analysis of rotor blades in hover and forward flight were developed and incorporated in a comprehensive package capable of performing aeroelastic tailoring of rotor blades in forward flight. The results indicate that substantial vibration reductions, of order 15-40%, in the vibratory hub shears can be achieved by relatively small modifications of the initial design.

83-1747

Sampling Strategies for Monitoring Noise in the Vicinity of Airports

P.D. Schomer, R.E. DeVor, and W.A. Kline
U.S. Army Construction Engrg. Res. Lab., Champaign, IL 61820, J. Acoust. Soc. Amer., 73 (6), pp 2041-2050 (June 1983) 7 figs, 5 tables, 7 refs

Key Words: Airports, Noise measurement, Aircraft noise

This paper is the third in a series dealing with the development of temporal sampling strategies for estimation of mean noise levels in the vicinity of airports. It extends the previous analysis for westcoast, one-direction airports (due to prevailing winds) to eastcoast, multidirection airports (Boston Logan, Washington Dulles, and National). The results show that the data for many of the eastcoast airport sites are nonstationary in the mean level and the corresponding consecutive sampling requirements predicted by the Dynamic Data System (DDS) methodology are very large, at times exceeding 1/3 of a year. When the data are stationary, Monte Carlo simulations using the data produce sampling requirements comparable to the values obtained by the DDS methodology. However, the DDS methodology tends to overestimate sampling requirements for nonstationary data. The simulations demonstrate that nonconsecutive sampling strategies reduce the overall sampling requirements for nonstationary data. In general, the results reveal the following: (a) Westcoast (one-direction); ± 50% precision – four weeks, any sampling strategy, ± 35% precision – eight weeks, any sampling strategy. (b) Eastcoast (multidirection); ± 60% precision – four weeks, one from each quarter, ±40% precision – eight weeks, one from each eighth.

83-1748

Helicopter Noise Exposure Curves for Use in Environmental Impact Assessment

J.S. Newman, E.J. Rickley, and T.L. Blanc
Office of Environment and Energy, Federal Aviation Admn., Washington, DC, Rept. No. DOT/FAA/EE 82-16, 160 pp (Nov 1982)
AD-A123 467

Key Words: Helicopter noise

This report establishes the current (1982) FAA helicopter noise data base for use in environmental impact assessment. The report sets out assumptions, methodologies, and techniques used in arriving at noise-exposure-versus-distance relationships. Noise data are provided for 15 helicopters, including five flight regimes each: takeoff, approach, level flyover, hover in-ground-effect and hover out-of-ground effect.

83-1749

A Survey of Helicopter and Ambient Urban Noise Levels in Phoenix, Arizona

J.S. Newman
Office of Environment and Energy, Federal Aviation Admn., Washington, DC, Rept. No. FAA/EE-82-20, 44 pp (Sept 1982)
AD-A123 856

Key Words: Helicopter noise, Noise measurement

The FAA has been conducting controlled helicopter noise measurement programs since 1976. The data have been used for a variety of purposes including evaluation of proposed U.S. and international noise standards, validation of helicopter noise prediction methodologies, and development of practical heliport design guidance. In order to supplement the results of the controlled tests, field survey data are also being gathered to represent in-service operating conditions. Measurements are intended to represent helicopter noise within the context of urban ambient background noise. The results reported in this document are termed "survey measurement," as opposed to controlled test data, in order to reflect the limited control imposed over factors which contribute to the variability of measured noise levels.

83-1750

Coupled Rotor/Airframe Vibration Analysis

R. Sopher, R.E. Studwell, S. Cassarino, and S.B.R. Kottapalli
Sikorsky Aircraft Div., United Technologies Corp., Stratford, CT, Rept. No. NASA-CR-3582, 205 pp (Nov 1982)
N83-14105

Key Words: Helicopters, Vibration analysis, Computer programs

A coupled rotor/airframe vibration analysis developed as a design tool for predicting helicopter vibrations and a research tool to quantify the effects of structural properties, aerodynamic interactions, and vibration reduction devices on vehicle vibration levels is described. The analysis consists of a base program utilizing an impedance matching technique to represent the coupled rotor/airframe dynamics of the system supported by inputs from several external programs supplying sophisticated rotor and airframe aerodynamic and structural dynamic representation. The theoretical background, computer program capabilities and limited correlation results are presented in this report.

83-1751

Dynamic Structural Aeroelastic Stability Testing of the XV-15 Tilt Rotor Research Aircraft

L.G. Schroers

NASA Ames Res. Ctr., Moffett Field, CA, Rept. No. NASA-A-9081, NASA-TM-84293, 21 pp (Dec 1982) AD-A123 857

Key Words: Rotors, Aeroelasticity, Aircraft, Helicopters, Experimental test data, Dynamic stability

For the past 20 years, a significant effort has been made to understand and predict the structural aeroelastic stability characteristics of the tilt rotor concept. Beginning with the rotor-pylon oscillation of the XV-3 aircraft, the problem was identified and then subjected to a series of theoretical studies, plus model and full-scale wind tunnel tests. From this data base, methods were developed to predict the structural aeroelastic stability characteristics of XV-15 tilt rotor research aircraft. This paper examines the predicted aeroelastic characteristics in light of the major parameters effecting rotor-pylon-wing stability; describes flight test techniques used to obtain XV-15 aeroelastic stability; presents a summary of flight test results; compares the flight test results to the predicted values; and presents a limited comparison of wind tunnel results, flight test results, and their correlation with predicted values.

83-1752

The Effects of Slight Non-Linearities on Modal Testing of Helicopter-Like Structures

D.J. Ewins

Imperial College of Science and Technology, London SW7 2BX, UK, Vertica, 7 (1), pp 1-8 (1983) 11 figs, 6 refs

Key Words: Helicopters, Modal tests, Single-point excitation technique

A comprehensive series of modal tests has been made on a specially-built test piece designed to simulate many of the characteristics of helicopter structures. These tests identified the presence of a slight degree of nonlinearity and further established that this almost-unnoticed effect causes significant discrepancies in the modal properties deduced from measured data. However, systematic analysis of the measurements may be used to isolate the nonlinear effects and to eliminate them from the results.

BIOLOGICAL SYSTEMS

HUMAN

(Also see No. 1740)

83-1753

The Interaction of Vehicle Occupants During Crash Tests (Gegenseitige Beeinflussung von Fahrzeuginsassen in Aufprallversuchen)

E. Faerber and H.J. Kruger

Ostmerheimer Strasse 257, 5000 Koln 91, Automobiltech Z., 85 (3), pp 125-132 (Mar 1983) 9 figs, 6 tables, 15 refs

(In German)

Key Words: Collision research (automotive), Human response

Actual testing and the literature on the subject reveal that in certain types of accidents, vehicle occupants can inflict injuries on one another in addition to those related directly to the vehicle. In order to quantify the rate of risk by means of dummy loads and to analyze the phenomena of interaction among multiple occupants, 70 full-scale crashes and 85 sled tests in various directions and at different collision speeds were performed.

ANIMAL

83-1754

On the Undamped Natural Frequencies and Mode Shapes of a Finite-Element Model of the Cat Eardrum

W.R.J. Funnell

BioMedical Engrg. Unit and Dept. of Otolaryngology, McGill Univ., 3655, rue Drummond, Montreal, Quebec, Canada H3G 1Y6, J. Acoust. Soc. Amer., 73 (5), pp 1657-1661 (May 1983) 6 figs, 8 refs

Key Words: Mathematical models, Ears, Natural frequencies, Mode shapes, Undamped structures

This paper presents a three-dimensional finite-element model of the cat eardrum which includes inertial effects. The model is implemented using a hierarchical modeling scheme which permits the mesh resolution to be varied. The static behavior

of the model is calculated as a function of mesh resolution in order to check the validity of an earlier model. The first six undamped natural frequencies, and the corresponding modal vibration patterns, are then calculated. The effects on the natural frequencies of varying seven parameters of the model are described.

MECHANICAL COMPONENTS

ABSORBERS AND ISOLATORS

(Also see Nos. 1744, 1849)

83-1755

A Study on the Torsional Dynamic Vibration Absorber Consisting of Rare-earth Magnets

H. Kojima and K. Nagaya
Gunma Univ., 1-5-1 Tenjin-cho, Kiryu, Gunma-ken, Japan, Bull. JSME, 26 (214), pp 611-618 (Apr 1983) 10 figs, 9 refs

Key Words: Dynamic vibration absorption (equipment), Torsional vibration, Magnetic damping

A new torsional dynamic vibration absorber is proposed, consisting of a circular conducting plate and four cylindrical rare-earth magnets. Its absorbing characteristics are investigated experimentally and theoretically.

83-1756

Power Plant Fan Vibration-Absorber Systems

G.A. Brewer
Brewer Engrg. Labs., Inc., Marion, MA, S/V, Sound Vib., 17 (4), pp 20-22 (Apr 1983) 7 figs, 5 refs

Key Words: Vibration absorption (equipment), Fans

During the start-up and in the initial operations of a power plant, induced draft fans experienced severe vibration excursions, limiting the ramp rate of the plant as well as the power output. An eight-unit absorber system was designed to suppress the vibration generated by the wandering rotor unbalance resulting from thermal distortion. Typical operating levels for transverse vibration of the bearing housings are now 1 to 2 mils peak to peak. Without the absorbers, operating levels were in the range of 10 to 20 mils and ramping was limited to 2 Mw/min.

83-1757

Soft Landing Gear

L.T. Kramer, F.H. Butler, and A.V. Camino
Dept. of the Air Force, Washington, DC, U.S. Patent No. 4 359 199, 7 pp (Nov 16, 1982)

Key Words: Landing gear, Aircraft

This patent describes a bogie type landing gear especially suitable for providing soft landing capabilities for short take-off and landing aircraft wherein fore and aft wheels are mounted on opposite ends of a vertical shock strut.

83-1758

The Response of Active and Semi-Active Suspensions to Realistic Feedback Signals

D.L. Margolis
Dept. of Mech. Engrg., Univ. of California, Davis, CA 95616, Vehicle Syst. Dynam., 11 (5-6), pp 267-282 (Dec 1982) 7 figs, 7 refs

Key Words: Suspension systems (vehicles), Active isolation, Semiactive isolation

A simple vehicle model is presented incorporating passive, active, and semi-active suspensions. When the desired feedback variables are ideally available, the system response is well understood and excellent sprung mass isolation results. More often than not, the measured variables must be signal processed in some manner prior to their use in some control algorithm. This paper presents the expected response of a simple vehicle with an active and/or semi-active suspension, subject to non-ideal feedback information.

83-1759

Vibration Isolation and Pressure Compensation Apparatus for Sensitive Instrumentation

R.D. Averill
NASA Langley Res. Ctr., Hampton, VA, U.S. Patent Appl. No. 6-408 575, 15 pp (Aug 16, 1982)

Key Words: Vibration isolators

A system for attenuating the inherent vibration associated with a mechanical refrigeration unit employed to cryogenically cool sensitive instruments used in measuring chemical constituents of the atmosphere is described. A modular system including an insrument housing and a reaction bracket with a refrigerator unit floated therebetween compromise the instrumentation system.

83-1760

Design and Test of Aircraft Engine Isolators for Reduced Interior Noise

J.F. Unruh and D.C. Scheidt

Southwest Res. Inst., San Antonio, TX, Rept. No. SRI-06-4860, NASA-CR-166021, 118 pp (Dec 1982)

N83-15042

Key Words: Isolators, Vibration isolators, Noise reduction, Aircraft engines, Aircraft noise

Improved engine vibration isolation was proposed to be the most weight and cost efficient retrofit structure-borne noise control measure for single engine general aviation aircraft. A study was carried out to develop an engine isolator design specification for reduced interior noise transmission, select/design candidate isolators to meet a 15 dB noise reduction design goal, and carry out a proof of concept evaluation test. Analytical model of the engine, vibration isolators and engine mount structure were coupled to an empirical model of the fuselage for noise transmission evaluation. The model was used to develop engine isolator dynamic properties design specification for reduced noise transmission.

TIRES AND WHEELS

83-1761

Coriolis and Centripetal Accelerations on In-Service Tire Vibrations

K. Dovstam and N. Nilsson

IFM Akustikbyran A.B., Stockholm, Sweden, Rept. No. IFM/TR-6.371.01, 34 pp (Oct 1981)

PB83-145185

Key Words: Tires, Vibration generation, Noise generation

Coriolis and centripetal acceleration have been referred to as a conceivable mechanism that could influence tire vibration and its existing noise. If such an influence exists, then a more detailed knowledge could be a powerful tool in developing less noisy tire designs. In the performed analysis the tire tread block is viewed as an Euler/Bernoulli beam of incompressible material. The treatment of the problem included transformation of measured vibration data in the fixed system to the rotating system utilizing a specially developed computer program.

83-1762

A Geometrically Nonlinear Shell Finite Element for Tire Vibration Analysis

C.J. Hunckler, T.Y. Yang, and W. Soedel

Purdue Univ., West Lafayette, IN 47907, Computers Struc., 17 (2), pp 217-225 (1983) 9 figs, 6 tables, 38 refs

Key Words: Tires, Vibration analysis, Shells, Finite element technique

An axisymmetric finite element is developed which includes such features as orthotropic material properties, doubly curved geometry, and both the first and second order nonlinear stiffness terms. This element can be used to predict the equilibrium state of an axisymmetric shell structure with geometrically nonlinear large displacements. Small amplitude vibration analysis can then be performed based on this equilibrium state.

83-1763

Self-excited Vibrations of the Tire

Z.J. Goraj

Inst. of Aircraft Engrg. and Appl. Mechanics, Tech. Univ. of Warsaw, Poland, Vehicle Syst. Dynam., 11 (5-6), pp 345-362 (Dec 1982) 11 figs, 6 refs

Key Words: Tires, Pneumatic tires, Self-excited vibrations, Frequency response, Strings

The mechanical work of external forces and torques acting on a tire is considered. A theory is developed for the prediction of necessary conditions for self-exciting vibrations. The theory establishes that the mechanical work of external forces and torques must be positive, or, what is equivalent, that the tire has to transmit energy from external environment to vehicle.

83-1764

Noise Test-Resilient Wheels, Massachusetts Bay Transportation Authority, Green Line

E.J. Rickley and M.J. Brien

Transportation Systems Ctr., Cambridge, MA, Rept. No. DOT-TSC-UMTA-82-16, UMTA-MA-06-0099-92-4, 80 pp (Nov 1982)

PB83-148635

Key Words: Railway wheels, Wheels, Transportation vehicles, Noise measurement

This document presents the results of noise and ground-borne vibration measurements made for three rail transit

vehicles operating on the Green Line of the Massachusetts Bay Transportation Authority (MBTA). The purpose of these measurements was to assess the noise and vibration performance of Sab-V resilient wheels compared with Acoustaflex (resilient) and solid-steel wheels, both in current use. The data presented in this report include comparative noise and vibration time histories, one-third octave and narrow band spectral analysis, and in-car statistical noise data.

83-1765

Flange Force Effects on the Motion of a Train Wheelset

M.A. Lohe and R.R. Huilgol

School of Mathematical Sciences, Flinders Univ. of South Australia, South Australia, 5042, Vehicle Syst. Dynam., 11 (5-6), pp 283-303 (Dec 1982) 8 figs, 14 refs

Key Words: Wheelsets, Railroad trains, Hunting motion, Flanges, Railroad tracks, Bifurcation theory

The motion of a train wheelset is investigated using Hopf bifurcation theory. The method takes full account of the nonlinear effects of the flange-rail contact forces which are incorporated in the model. The numerical solution is obtained over a wide range of forward speeds by transforming the bifurcation problem into a regular nonlinear boundary value problem, which is solved by standard methods. This solution is shown to be orbitally, asymptotically stable. The algorithm supplies complete information on the lateral and yaw motions and on the period of oscillation, even for very high forward speeds.

83-1766

Elasto-Plastic Stress Analysis and Fatigue Life Prediction of a Freight Car Wheel under Mechanical and Cyclic Thermal Loads

T.J. Thomas, S. Nair, and V.K. Garg

Illinois Inst. of Tech., Chicago, IL 60615, Computers Struc., 17 (3), pp 313-320 (1983) 2 figs, 2 tables, 35 refs

Key Words: Freight cars, Wheels, Fatigue life, Temperature effects, Cyclic loading

The elasto-plastic finite element analyses of a 36 in. dia. freight car wheel, subjected to cyclic thermal loads in presence of mechanical loads and cyclic mechanical loads in presence of thermal loads, were conducted. The stresses and strains computed for these loading conditions were then used to predict the fatigue life of a wheel subjected to a random load history.

BLADES

(Also see No. 1702)

83-1767

The Aerodynamics of a Rotor Blade of Last Stage of Steam Turbine of Large Output

M. Stastny and P. Safarik

SKODA Works, Plzen, Czechoslovakia; Inst. of Thermomechanics, Czechoslovak Academy of Sciences, Prague, Czechoslovakia, Strojnicky Casopis, 34 (1-2), pp 41-52 (1983) 8 figs, 1 table, 6 refs

(In Czech)

Key Words: Blades, Rotor blades (turbomachinery), Aerodynamic loads

An aerodynamic research of several two dimensional sections of a rotor blade 1050 mm of the last stage of a steam turbine of large output with 3000 t.p.m. is carried out. It is based on the conception of SKODA Works turbine design. Some research results of transonic flow past selected sections are presented. Discussion of the results bring new knowledge of structure and parameters of flow and suggestions for application in machine design.

83-1768

Blade Vibration in Impellers of Highly Loaded Centrifugal Compressors (Schaufelschwingungen an Laufrädern hochbelasteter Radialverdichter)

U. Haupt and M. Rautenberg

Feuerwehrplatz 1, D-3015 Wennigsen 1, MTZ Motortech. Z., 44 (4), pp 123-129 (Apr 1983) 14 figs, 5 refs

(In German)

Key Words: Blades, Turbomachinery blades, Compressor blades, Centrifugal compressors, Vibration analysis

Blade vibration in highly loaded radial impellers with thin blades for centrifugal compressors or turbochargers often reaches dangerous levels. Thus, a broad research program was established to investigate the excitation mechanism and the intensity of blade vibration in different operating ranges of such compressors. Blade frequencies, vibration modes and

stress distributions were obtained by means of FE-calculations and vibration tests with a compressor at rest. Semiconductor strain gages and a multichannel telemetry system were used for measurements on compressors in operation.

83-1769

Turbine Blade Nonlinear Structural and Life Analysis

R.L. McKnight, J.H. Laflen, G.R. Halford, and A. Kaufman

General Electric Co., Cincinnati, OH, J. Aircraft, 20 (5), pp 475-480 (May 1983) 8 figs, 4 tables, 9 refs

Key Words: Blades, Turbine blades, Fatigue life

The utility of advanced structural analysis and life prediction techniques was evaluated for the life assessment of a commercial air-cooled turbine blade with a history of tip cracking. Three-dimensional nonlinear finite-element structural analyses were performed for the blade tip region. The computed strain-temperature history of the critical location was imposed on a uniaxial strain controlled test specimen to evaluate the validity of the structural analysis method.

83-1770

The Effect of Blade Discretization on Resonant Turbine Blade Response

C. Sheng and J.G. Mosimann

Perkin-Elmer Corp., Danbury, CT, ASME Paper No. 83-GT-158

Key Words: Blades, Turbine blades, Resonant response, Timoshenko theory, Beams

The two methods currently used in industry to calculate blade resonant responses, the energy method and the transmissibility method, are discussed relative to accuracy and facility. Although identical in form for the ideal case, the methods differ in accuracy for practical cases depending on discretization, i.e., model lumped mass breakup fineness. For clarity, the equations for these two methods are derived for a Timoshenko beam and solved numerically for a beam with varying discretization.

83-1771

A Three-Dimensional Model for the Prediction of Shock Losses in Compressor Blade Rows

A.J. Wennerstrom and S.L. Puterbaugh

Aero Propulsion Lab., Wright-Patterson AFB, OH, ASME Paper No. 83-GT-216

Key Words: Blades, Compressor blades, Shock response

A new model for predicting the shock loss through a transonic or supersonic compressor blade row operating at peak efficiency is presented. It differs from the classical Miller-Lewis-Hartmann normal shock model by taking into account the spanwise obliquity of the shock surface due to leading-edge sweep, blade twist, and solidity variation.

83-1772

An Investigation into the Effect of Coolant Flow on the Vibration Characteristics of Hollow Blades Conveying Fluids

B.A. Abuid and A.M. Al-Jumaily

Univ. of Baghdad, Iraq, ASME Paper No. 83-GT-217

Key Words: Blades, Turbomachinery blades, Fluid-induced excitation, Fluid-filled media, Shells

The free vibration of hollow symmetrical turbomachinery blades conveying cooling fluid is treated. The blade motion is described by using a simplified shell theory, whereas the fluid forces are described by the linearized potential flow theory.

83-1773

On the Importance of Shear Deformation, Rotatory Inertia and Coriolis Forces in Turbine Blade Vibrations

K.A. Ansari

Univ. of Petroleum and Minerals, Dhahran, Saudi Arabia, ASME Paper No. 83-GT-167

Key Words: Blades, Turbine blades, Transverse shear deformation effects, Rotatory inertia effects, Coriolis forces

This paper is concerned with the significance of the effects of shear deformation, rotatory inertia, and Coriolis forces in the analysis of turbine blade vibrations. Since these are quite pronounced at the high-frequency ranges encountered in turbine blade vibration problems, they should not be overlooked, although their inclusion paves the way for a complicated nonlinear analysis. An approximate analysis technique is presented which involves an application of the stationary functional method using the normal modes of a discretized model.

83-1774

Vibration Analysis of Turbomachinery Blades by Shell Theory

A.-J. Wang

Ph.D. Thesis, Ohio State Univ., 193 pp (1982)

DA8305407

Key Words: Blades, Turbomachinery blades, Finite element technique, Shells

Turbomachinery blades have been for decades a technical field of considerable importance. The finite element method has been widely used in blade vibration analysis by employing thin or thick shell and three-dimensional elements. The present studies are to develop and advance alternate analytical methods that are economical and well suited for parameter studies showing the effects of changing aspect ratio, thickness ratio, shallowness, pretwist, disk radius and angular velocity upon the frequencies and mode shapes. Parameter studies are essential and particularly useful in obtaining a physical understanding of the problem and in preliminary design. The Ritz method, the Reissner's variational principle, the Trefftz method, and a modified lower bound method are investigated. Special attention is given to convergence and bounds.

83-1775

Modeling of the Transmissibility through Rolling-Element Bearings under Radial and Moment Loads

M.D. Rajab

Ph.D. Thesis, Ohio State Univ., 286 pp (1982)

DA8305382

Key Words: Bearings, Rolling contact bearings, Machinery vibration

Vibrations of rotating machinery housing panels are typically the result of the transmission of force excitations through the bearings of shaft-mounted elements such as gears and rotors. The location and type of bearings which support the shafts in these machine housings has a profound effect on the transmission of moments and forces from the shaft to the housing. The work presented in this dissertation focuses on the modeling of rolling-element bearings under radial loads, bending moments, and/or axial loads. Under these loads, the bearing was modeled by radial and rotational stiffnesses.

83-1776

Measurements of Self-Excited Rotor-Blade Vibrations Using Optical Displacements

A.P. Kurkov

NASA Lewis Res. Ctr., Cleveland, OH, Rept. No. E-1368, NASA-TM-82953, 13 pp (1982) (Proposed for presentation at the 28th Ann. Intl. Gas Turbine Conf., Phoenix, AZ, Mar 27-31, 1983)

N83-14523

Key Words: Blades, Fan blades, Turbofan engines, Vibration measurement

The characteristics of optical displacement spectra and their role of monitoring rotor blade vibrations are discussed. During the operation of a turbofan engine at part speed, near stall, and elevated inlet pressure and temperature, several vibratory instabilities were excited simultaneously on the first fan rotor. The torsional and bending contributions to the main flutter mode were resolved by using casing-mounted optical displacement sensors. Other instabilities in the blade deflection spectra were identified.

83-1777

Critical Review of the Trailing Edge Condition in Steady and Unsteady Flow. Blade Flutter in Compressors and Fans: Numerical Simulation of the Aerodynamic Loading

S.F. Radwan, D.O. Rockwell, and S.H. Johnson

Dept. of Mech. Engrg., Lehigh Univ., Bethlehem, PA, Rept. No. NASA-CR-169705, 149 pp (Dec 1982)

N83-15264

Key Words: Blades, Compressor blades, Fan blades

Existing interpretations of the trailing edge condition, addressing both theoretical and experimental works in steady, as well as unsteady flows are critically reviewed. The work of Kutta and Joukowski on the trailing edge condition in steady flow is reviewed.

83-1778

Effects of Structural Coupling on Mistuned Cascade Flutter and Response

R.E. Kielb and K.R.V. Kaza

NASA Lewis Res. Ctr., Cleveland, OH, Rept. No. E-1500, NASA-TM-83049, 17 pp (1983)

N83-15672

Key Words: Flutter, Blades, Cascade

The effects of structural coupling on mistuned cascade flutter and response are analytically investigated using an

extended typical section model. This model includes both structural and aerodynamic coupling between the blades.

83-1779

Reduction of High-Speed Impulsive Noise by Blade Planform Modification of a Model Helicopter Rotor

D.A. Conner and D.R. Hoad

NASA Langley Res. Ctr., Hampton, VA, Rept. No. NASA-TM-84553, 62 pp (Dec 1982)

AD-A123 499

Key Words: Blades, Propeller blades, Geometric effects, Helicopter noise, Noise reduction

An experiment was performed to investigate the reduction of high-speed impulsive noise for the UH-1H helicopter by using an advanced main rotor system. The advanced rotor system had a tapered blade planform compared with the rectangular planform of the standard rotor system. Models of both the advanced main rotor system and the UH-1H standard main rotor system were tested at 1/4 scale.

BEARINGS

(Also see No. 1889)

83-1780

Fatigue Life of Composite Bearing Materials under the Action of Pressure Oil on the Surface (Lebensdauer von Lagerverbundwerkstoffen bei Einwirkung von Drücköl auf die Oberfläche)

H. Peeken and R. Schuller

Institut für Maschinenelemente und Maschinengestaltung der RWTH Aachen, Fed. Rep. Germany, Konstruktion, 35 (4), pp 141-146 (Apr 1983) 12 figs, 4 refs

(In German)

Key Words: Bearings, Friction bearings, Fatigue life, Fatigue (materials), Composite materials

In the design of dynamically loaded friction bearings fatigue and endurance tests of bearing material should be carried out. The article deals with the determination of the strength of composite bearing materials and with the application of these results to actual friction bearings.

83-1781

An Investigation into the Effect of Side-Plate Clearance in an Uncentralized Squeeze-Film Damper

R.A. Cookson and L.J. Dainton

Cranfield Inst. of Tech., UK, ASME Paper No. 83-GT-176

Key Words: Bearings, Squeeze-film bearings, Squeeze-film dampers

An experimental investigation was carried out into the influence of side-plate flow restrictors on the performance of a squeeze-film damper bearing. The experimental rig used was a flexible rotor with a disc positioned midway between two squeeze-film damper bearings. One of the squeeze-film dampers was fitted with side plates which could be adjusted and accurately located with respect to the squeeze-film damper journal.

83-1782

The Effect of Fluid Inertia in Squeeze Film Damper Bearings: A Heuristic and Physical Description

J.A. Tichy

Rensselaer Polytechnic Inst., Troy, NY, ASME Paper No. 83-GT-177

Key Words: Bearings, Squeeze-film bearings, Squeeze-film dampers, Turbulence

Some speculative discussion on turbulence effects in squeeze-film dampers is presented. The common notion in hydrodynamic lubrication of a small brief laminar inertia region followed shortly by transition to turbulence does not appear to be true. For squeeze-film dampers, simple analysis based on boundary layer considerations yields quite different conclusions, as supported by recent experiments.

GEARS

(Also see No. 1907)

83-1783

Computer Aided Design of Multi-Stage Gears on Parallel Axes by Means of Dynamic Optimization (Rechnerunterstützter Entwurfmehrstufiger Stirnradgetriebe mit Hilfe dynamischer Optimierung)

Ch. Scheurer, R. Tichatschke, S. Schonfeld, and M. Vogel

Technische Hochschule Karl-Marx-Stadt, Sektion Mathematik, Maschinenbautechnik, 32 (3), pp 118-122 (Mar 1983) 4 figs, 1 table, 9 refs
(In German)

Key Words: Gears, Optimization, Computer programs

A method for the optimization of multi-stage gears on parallel axes is presented. A computer program and an example are also given.

COUPLINGS
(See No. 1904)

FASTENERS
(Also see Nos. 1912, 1926)

83-1784
Fatigue Testing of Bolted Joints in Humid Air and Alternating Immersion
L. Jarfall and A. Magnusson
Aeronautical Res. Inst. of Sweden, Stockholm, Sweden, Rept. No. FFA-TN-1982-34, 22 pp (Sept 16, 1982)
N83-14549

Key Words: Joints (junctions), Bolted joints, Fatigue tests

Bolted joint specimens were fatigue tested in a humid air environment with condensation and in an environment involving alternating immersion in distilled water. Comparisons were done with results in other laboratories obtained with laboratory air environment and with salt spray environment.

83-1785
Effects of Anomalous Rotor Joints on Turbomachine Dynamics
N. Klompas
General Electric Co., Schenectady, NY, ASME Paper No. 83-GT-175

Key Words: Joints (junctions), Turbomachinery, Restoring factors

Mechanisms simulating rotor joint restoring moments different from the common axisymmetric elastic hinge are derived and their effects on the dynamics of a complete turbomachine are calculated by impressing equivalent perturbing moments. A mechanism for locking subsynchronous whirl to a fractional frequency is described and supporting experimental observations are discussed.

SEALS

83-1786
A Case Study of Oil-Film Seal Failure in a High-Speed Centrifugal Compressor
D.L. St. John
Shell Oil Co., Wood River, IL 62095, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983, Spons. Vibration Institute, Clarendon Hills, IL, pp 187-190, 9 figs, 1 ref

Key Words: Compressors, Centrifugal compressors, Seals, Vibration excitation

This paper concerns critical speed, vibration-induced seal failure in a large high-speed centrifugal compressor. A method of impulse response testing of a rotor to determine its natural frequencies at different rotor support positions is demonstrated. A seal remedy which allows trouble-free operation of the compressor without a major seal redesign is also described.

83-1787
Fluid Film Dynamic Coefficients in Mechanical Face Seals
I. Green and I. Etsion
Dept. of Mech. Engrg., Technion, Haifa, Israel, J. Lubric. Tech., Trans. ASME, 105 (2), pp 297-302 (Apr 1983) 6 figs, 1 table, 19 refs

Key Words: Seals, Stiffness coefficients, Damping coefficients

The stiffness and damping coefficients of the fluid film in mechanical face seals are calculated for the three major degrees of freedom of the primary seal ring. The calculation is based on small perturbation of the ring from its equilibrium position. Analytical expressions are presented for the various coefficients and a comparison is made with the results of accurate but more complex analyses to establish the range of applicability.

STRUCTURAL COMPONENTS

STRINGS AND ROPES

83-1788

A Parametrically Driven Harmonic Analysis of a Non-Linear Stretched String with Time-Varying Length

G. Tagata
Nippon Gakki Company Ltd., 10-1, Nakazawa-Cho, Hamamatsu, Japan, J. Sound Vib., 87 (3), pp 493-511 (Apr 8, 1983) 2 figs, 13 refs

Key Words: Strings, Harmonic response, Time-dependent parameters

This paper is concerned with the first, second and third harmonic lateral vibrations of a string having a forced, periodic, small length variation. Account is taken of the non-linear term arising from the correction to the tension of the string due to local elongation. It is found that increasing the amplitude of the length variation of the string results in a narrowing of the frequency response range of each of the harmonic oscillation components. Both numerical and analytical calculations of the harmonic frequency responses are carried out.

CABLES

83-1789

Dynamic Stiffness of Parabolic Cables

A.S. Veletsos and G.R. Darbre
Dept. of Civil Engrg., Rice Univ., Houston, TX 77251, Intl. J. Earthquake Engrg. Struc. Dynam., 11 (3), pp 367-401 (May/June 1983) 21 figs, 1 table, 10 refs

Key Words: Cables, Dynamic stiffness

A closed-form expression for the in-plane horizontal stiffness of a viscously damped, uniform, inclined cable in harmonic motion is presented. The cable is presumed to be deflected in a parabolic profile at its position of static equilibrium, and all dynamic displacements are assumed to be small. The stiffness expression is valid for an arbitrary angle of inclination of the cable chord in the range between zero and 90 degrees. In addition, a simpler solution, valid over a narrower range of the parameters, is included and its accuracy examined. Comprehensive numerical data are presented and discussed.

83-1790

Inelastic Dynamic Response of Cable Networks

M. Papadrakakis
Inst. of Struct. Analysis and Aseismic Res., Natl. Technical Univ., Athens, Greece, ASCE J. Struc. Engrg., 109 (5), pp 1139-1154 (May 1983) 12 figs, 3 tables, 25 refs

Key Words: Cables

The ultimate carrying capacity of cable networks under dynamic loading is investigated. Geometric as well as physical nonlinearities are considered. The explicit Newmark's β method, with $\beta = 0$, is used to integrate the equations of motion.

83-1791

Cable Dynamics in an Ocean Environment

H. Tuah
Ph.D. Thesis, Oregon State Univ., 154 pp (1983) DA8304699

Key Words: Cables, Fluid-induced excitation

The nonlinear dynamic analysis of cable and cable-large body systems subject to both deterministic and nondeterministic loading is presented. Nonlinearities occur due to large displacements, material nonlinearity, lack of stiffness in compression, and the nonconservative fluid loading. A finite element model is used to model the cable and rigid motions of the large body. The linearized incremental equations of motion for both linear elastic and viscoelastic materials are derived. Solution procedures for both static and dynamic analyses are presented.

BEAMS

(Also see Nos. 1824, 1851)

83-1792

Towards an Optimum Model for the Response of Reinforced Concrete Beams to Cyclic Loads

J.F. Stanton and H.D. McNiven

Dept. of Civil Engrg., Univ. of Washington, Seattle, WA 98195, Intl. J. Earthquake Engrg. Struc. Dynam., 11 (3), pp 299-312 (May/June 1983) 12 figs, 24 refs

Key Words: Beams, Reinforced concrete, Cyclic loading, Flexural response

The paper describes the development of a mathematical model tc predict the flexural response of reinforced concrete beams to severe cyclic loading. The model is constructed with the aid of System Identification, which permits the coefficients in it to be so tuned as to replicate with the maximum possible accuracy the results of physical experiments. Comparisons between observed and predicted behavior are presented, both for the steel alone and for the composite material.

83-1793

Mathematical Analogue for Design of Linear Strain-hardening Beam

M. Šukšta and A. Čižas

Vilnius Civil Engrg. Inst., Vilnius Lithuanian SSR, "Formulation and Solution of Structural Mechanics Problems," The Ministry of Higher and Special Learning of Lithuanian SSR and Vilnius Civil Engrg. Inst., 1982, pp 5-13, 2 figs, 3 refs
(In Russian)

Key Words: Beams, Optimization, Random excitation

Mathematical analogue for the optimization problem of beam in case of repeated load is formulated as a linear programming problem. The cross-sections of optimal beam system may be taken from the given set only. The algorithm and program for computer ES-1022 are developed.

83-1794

A Study of Shear Factors in Reduced-Selective Integration Mindlin Beam Elements

W.L. Mindle and T. Belytschko

Dept. of Civil Engrg., Northwestern Univ., Evanston, IL 60201, Computers Struc., 17 (3), pp 339-344 (1983) 6 figs, 4 tables, 9 refs

Key Words: Beams, Transverse shear deformation effect, Mindlin theory

The influence of the shear correction factor on the convergence of a reduced-selective integration Mindlin beam element is investigated for structural dynamics problems. This is accomplished through a frequency analysis of an infinite mesh and a single element, which shows that reduction of the shear factor lowers the maximum frequency of the mesh without affecting its spectral fidelity in low and moderate frequencies. This enables larger critical time steps to be used for explicit integration without disturbing convergence of the element.

83-1795

Buckling and Cyclic Inelastic Analysis of Steel Tubular Beam-Columns

D.J. Han and W.F. Chen

School of Civil Engrg., Purdue Univ., West Lafayette, IN 47907, Engrg. Struc., 5 (2), pp 119-132 (Apr 1983) 17 figs, 21 refs

Key Words: Tubes, Beam-columns, Cyclic loading, Finite segment method, Influence coefficient method, Off-shore structures, Drilling platforms

A numerical procedure combining the finite segment method (FSM) with the influence coefficient method (ICM) is presented for estimating the inelastic behavior of steel tubular beam-columns under post-buckling and cyclic loading conditions. This combination takes the advantages of FSM and ICM, overcoming the difficulties encountered in numerical analysis at the stages of buckling and post-buckling. The effects of initial imperfections, residual stresses, and end-restraints are taken into account. Generalized stress-strain relationships are used in the analysis. Complete results obtained for a pin-ended beam-column are discussed and compared with available theoretical results.

CYLINDERS

83-1796

Torsional Oscillation of a Semi-Infinite Circular Cylinder Acted on by an Impulsive Twist

J.G. Chakravorty

Dept. of Appl. Mathematics, Univ. College of Science, 92, Acharya Prafulla Chandra Rd., Calcutta - 700 009, India, Rev. Roumaine Sci. Tech., Mecanique Appl., 27 (4), pp 529-533 (1982) 1 fig, 2 refs

Key Words: Cylinders, Torsional vibration

A solution to the problem of torsional oscillation of a semi-infinite transversely isotropic circular cylinder whose plane

end is acted on by an *impulsive twist* is presented. Laplace transform technique is used to obtain the solution. An example is given for a particular type of twist and the stresses obtained are represented in a figure.

83-1797

Single- and Double-Wall Cylinder Noise Reduction

F.J. Balena, R.A. Prydz, and J.D. Revell

Lockheed-California Co., Burbank, CA, J. Aircraft, 20 (5), pp 434-439 (May 1983) 11 figs, 10 refs

Key Words: Cylinders, Noise reduction, Aircraft noise, Interior noise, Experimental test data

The noise reductions of three small cylinders covering a range of stiffness were measured in a reverberant field environment. A leaded-vinyl septum was used for an inner wall in double-wall configuration studies. The measured noise reduction data are compared with predicted noise reductions. An acoustical loss factor is introduced to improve the agreement between theory and experiment for the double-wall configurations.

PANELS

83-1798

Minimum-Weight Design of an Orthotropic Shear Panel with Fixed Flutter Speed

L. Beiner and L. Librescu

Ben-Gurion Univ. of the Negev, Beersheba, Israel, 23 pp (Oct 1982)

N83-15674

Key Words: Panels, Rectangular panels, Aerodynamic loads, Flutter, Minimum weight design

The weight minimization of a flat rectangular panel of arbitrary aspect ratio placed in a high supersonic flow field and subjected to a flutter speed constraint is studied. A pure transverse shear plate model was used to establish the structural operator.

83-1799

Study of the Damping Characteristics of General Aviation Aircraft Panels and Development of Computer Programs to Calculate the Effectiveness of Interior Noise Control Treatment, Part 1

R. Navaneethan, J. Hunt, and B. Quayle

Center for Research, Inc., Univ. of Kansas, Lawrence, KS, Rept. No. NASA-CR-169534, 103 pp (Dec 1982)

N83-15043

Key Words: Panels, Aircraft, Damping characteristics

Tests were carried out on 20 inch x 20 inch panels at different test conditions using free-free panels, clamped panels, and panels as installed in the KU-FRL acoustic test facility. Tests with free-free panels verified the basic equipment set-up and test procedure. They also provided a basis for comparison. Effects of damping tape, stiffeners, and bonded and riveted edged conditions were also investigated. Progress in the development of a simple interior noise level control program is reported.

83-1800

Nonlinear Supersonic Flutter of Panels Considering Shear Deformation and Rotary Inertia

K.S. Rao and G.V. Rao

Aerospace Structures Div., Vikram Sarabhai Space Ctr., Trivandrum 695022, India, Computers Struc., 17 (3), pp 361-364 (1983) 3 tables, 14 refs

Key Words: Panels, Flutter, Transverse shear deformation effects, Rotatory inertia effects

Nonlinear supersonic flutter of panels is studied for end conditions of simply supported, clamped and partial restraint against rotation by a unified approach. The effect of shear deformation and rotary inertia on nonlinear flutter boundary is studied for various thicknesses of panels.

PLATES

83-1801

Free Vibrations of an Isotropic Nonhomogeneous Infinite Plate of Linearly Varying Thickness

J.S. Tomar, D.C. Gupta, and N.C. Jain

Univ. of Roorkee, Roorkee, India, Meccanica, 18 (1), pp 30-33 (Mar 1983) 2 figs, 5 refs

Key Words: Plates, Variable cross section, Flexural vibration

The free transverse vibrations of an isotropic nonhomogeneous infinite plate of variable thickness have been studied on the basis of classical plate theory. The governing differential equation of motion has been solved by Frobenius method by expressing the transverse displacement as an infinite series. The frequencies corresponding to the first two modes of vibration are computed for different values of thickness variation constant, nonhomogeneity parameter, and different combinations of boundary conditions.

83-1802

Cyclic and Strain Stress of the Plate Elements in Concentration Zones and Limiting Conditions of the Crack Development

A. Žiliukas and K. Vaičiulis
Kaunas Polytechnical Inst., Kaunas, Lithuanian SSR,
"Formulation and Solution of Structural Mechanics Problems," The Ministry of Higher and Special Learning of Lithuanian SSR and Vilnius Civil Engrg. Inst., 1982, pp 61-64, 2 figs, 3 refs
(In Russian)

Key Words: Plates, Cyclic loading, Fracture properties

The paper presents the application of the stress concentration theory as well as plastic failure for determining the limiting cyclic stresses when the length and the opening of the crack are given.

83-1803

The Steady State Response of a Damped Circular Plate Driven at a Diameter

T. Irie, G. Yamada, and Y. Muramoto
Dept. of Mech. Engrg., Hokkaido Univ., Sapporo, 060 Japan,
J. Sound Vib., 86 (4), pp 485-496 (Feb 22, 1983) 6 figs, 2 tables, 14 refs

Key Words: Plates, Circular plates, Damped structures, Periodic response

The steady state response of a damped circular plate transversely or rotationally driven at a diameter is determined by the series-type method. With the reaction force or moment acting along a diameter of a circulate plate regarded as an unknown harmonic load, the response of the plate to the load is expressed by the Green function. The force or moment distribution along the diameter is expanded into Fourier series with unknown coefficients, and the simultaneous linear equations for the coefficients are derived by the restraint condition on the diameter. The dynamic response of the plate is determined by solving the equations. The method is applied to circular plates driven by a sinusoidally varying transverse deflection or angular rotation at a diameter, and the steady state response of the plates is studied.

83-1804

Vibration Analysis of a Spinning Disk Using Image Derotated Holographic Interferometry

J.C. MacBain, J.E. Horner, W.A. Stange, and J.S. Ogg
Air Force Aero Propulsion Lab., Wright-Patterson AFB, OH,
A Collection of Papers in the Aerospace Sciences, 7 pp (June 1982)
AD-A122 667
AD-P000 344

Key Words: Disks, Rotating structures, Steel, Holographic techniques, Interferometric techniques, Vibration analysis

The present work reports on the application of image derotated holographic interferometry to study the resonant response of a rotating steel disk at speeds up to 8000 RPM. The rotational motion of the disk is optically removed by passing the image of the rotating disk through a prism that is traveling at half the rotational speed of the disk. Off-axis double-pulsed laser holography is then used to record the disk resonant vibratory response. The first five diametrical modes and one of disk imbalance, misalignment of optical and mechanical axes of rotation and system-excited modes of vibration are also addressed. Selected experimental results are compared to those obtained using finite element analysis.

SHELLS

(Also see Nos. 1762, 1774)

83-1805

Vibrations of Cantilevered Doubly-Curved Shallow Shells

A.W. Leissa, J.K. Lee, and A.J. Wang
Dept. of Engrg. Mechanics, Ohio State Univ., Columbus, OH 43210,
Intl. J. Solids Struc., 19 (5), pp 411-424 (1983) 5 figs, 10 tables, 14 refs

Key Words: Shells, Cantilever plates, Turbomachinery blades, Geometric effects, Vibration response

Vibrational characteristics are determined for a previously unsolved class of problems, that of doubly-curved shallow shells having rectangular planforms, clamped along one edge

and free on the other three. The solution procedure uses the Ritz method with algebraic polynomial trial functions. Convergence studies are made, and accurate frequencies and contour plots of mode shapes are presented for various curvature ratios, including spherical, circular cylindrical and hyperbolic paraboloidal shells.

83-1806

Buckling of Steel Containment Shells. Task 1a: Dynamic Response and Buckling of Offshore Power Systems' Floating Nuclear Plant Containment Vessel

E. Meller and D. Bushnell
Lockheed Palo Alto Res. Labs., CA, Rept. No. LMSC-D812950-VOL-1-PT-1, 263 pp (Dec 1982) NUREG/CR-2836-V1-PT1

Key Words: Shells, Containment structures, Nuclear power plants, Off-shore structures, Computer programs

Static and dynamic analyses of the steel containment vessel of a floating nuclear plant were conducted with use of several computer programs. The main purpose was to evaluate the containment shell with respect to buckling. The report is divided into two main sections, the first giving results from modal vibration and linear dynamic response analyses of the containment neglecting and including the large equipment hatch and the second giving results from buckling analyses for a variety of models.

83-1807

Estimation of the Fundamental Frequencies of Shallow Shells by a Finite Element-Isodeflection Contour Method

D. Bucco and J. Mazumdar
Dept. of Appl. Mathematics, Univ. of Adelaide, Adelaide, South Australia, Computers Struc., 17 (3), pp 441-447 (1983) 6 figs, 4 tables, 20 refs

Key Words: Shells, Fundamental frequency, Finite element technique, Numerical methods

A simple, efficient and economical numerical technique for the estimation of the fundamental frequencies of shallow shells is presented. The technique is based upon the constant deflection contours method combined with the finite element method. In the proposed method, using Galerkin's criterion, the elemental stiffness and mass matrices are derived from a system of two consistent partial differential equations involving two scalar functions.

83-1808

Linear Dynamic Analysis of Revolutional Shells Using Finite Elements and Modal Expansion

Y.B. Chang, T.Y. Yang, and W. Soedel
School of Mech. Engrg., Purdue Univ., West Lafayette, IN 47907, J. Sound Vib., 86 (4), pp 523-538 (Feb 22, 1983) 9 figs, 21 refs

Key Words: Shells, Shells of revolution, Finite element technique

Doubly-curved, axisymmetric shell finite elements are used to perform the dynamic analysis of shells of revolution. The modal expansion method is used since it is more efficient than the direct integration method when the axisymmetric shell structures are subjected to certain specific loadings. For the case of complicated loadings such as traveling loads, the modal participation factors are obtained in the form of convolution integrals which can be solved either by Laplace transformation or by numerical integration. Orthogonality conditions between displacement functions and the Fourier expansions of loadings have been used to simplify the consistent loads.

83-1809

Dynamic Analysis of Thin Elastic Noncircular Conical Shells

K.P. Soldatos, C.V. Massalas, and G.J. Tzivanidis
Acta Mech., 46 (1-4), pp 207-232 (1983)

Key Words: Shells, Conical shells

The geometry of the middle surface lines of curvature of a thin conical shell, whose cross-section is bounded by a certain closed convex plane curve, is studied. Several sets of linear and nonlinear equations of motion are derived in terms of its middle surface orthogonal line-of-curvature coordinate system. As an application of the presented analysis, the free vibration problem of thin circular and elliptical frustums is investigated by means of linear Donnell-type equations of motion.

83-1810

Dynamic Characteristics of Conical Shell with Variable Modulus of Elasticity

C. Massalas, D. Dalamangas, and A. Raptis
Univ. of Ioannina, Greece, Rev. Roumaine Sci. Tech., Mecanique Appl., 27 (5), pp 609-628 (Sept/Oct 1982) 9 figs, 12 refs

Key Words: Shells, Conical shells, Variable material properties

The dynamic characteristics of a circular conical shell in which the modulus of elasticity is linearly varying along its generator are examined. The formulation of the problem is based on Donnell's linear theory and the mathematical analysis on Galerkin's method. The resulting algebraic eigenvalue problem is solved numerically and the results for the fundamental eigenfrequency and the correspondong mode shape are presented for clamped and simply supported shells.

83-1811

Impulsive Loading of a Cylindrical Shell with Transverse Shear and Rotatory Inertia

N. Jones and J.G. DeOliveira

Dept. of Mech. Engrg., The Univ. of Liverpool, P.O. Box 147, Liverpool L69 3BX, UK, Intl. J. Solids Struc., 19 (3), pp 263-279 (1983) 9 figs, 19 refs

Key Words: Shells, Cylindrical shells, Impulse response, Transverse shear deformation effects, Rotatory inertia effects

Theoretical solutions are presented for the dynamic response of a simply supported cylindrical shell which is loaded impulsively and made from a rigid perfectly plastic material. The influence of rotatory inertia in the equilibrium equations is examined and plastic behavior is controlled by a yield condition which retains the transverse shear force as well as the circumferential membrane force and longitudinal bending moment.

83-1812

The Input Mobility of an Infinite Circular Cylindrical Elastic Shell Filled with Fluid

C.R. Fuller

NASA Langley Res. Ctr., Hampton, VA 23665, J. Sound Vib., 87 (3), pp 409-427 (Apr 8, 1983) 9 figs, 1 table, 12 refs

Key Words: Shells, Cylindrical shells, Circular shells, Fluid-filled containers

The force input mobility of an infinite elastic circular cylindrical shell filled with fluid is derived by using the spectral equations of motion. Mobilities are evaluated and their physical interpretations are discussed for a steel shell of thickness $h/a = 0{\cdot}05$ filled with water and vibrating in the $n = 0$, 1 and 2 circumferential modes. The results are subsequently used to analyze the related situations of wave transmission through a radial ring constraint and the far field vibrational energy distributions between the contained fluid and the shell wall for line and point driving forces.

83-1813

Development of Model Methods in Dynamics

L. Pust

Inst. of Thermomechanics, Czechoslovak Academy of Sciences, Prague, Czechoslovakia, Strojnícky Časopis, 34 (1-2), pp 175-187 (1983) 11 figs, 7 refs (In Czech)

Key Words: Shells, Cylindrical shells, Spectrum analysis, Modal analysis

The possibilities of model-technique combined with the use of a data acquisition and control computer system for research in experimental dynamics is presented. An analog-digital measuring system is described and methods of record and evaluation of complex response curves are given. The aim of the research is to ascertain the spectral and modal properties of cylindrical shells and the dynamic stiffness of bearing supports of a stator.

83-1814

Natural Frequencies, Damping and Stability of a Structurally Damped Cylindrical Shell Conveying Fluid

J. Horáček and I. Zolotarev

Inst. of Thermomechanics, Czechoslovak Academy of Sciences, Prague, Czechoslovakia, Strojnícky Časopis, 34 (1-2), pp 189-204 (1983) 5 figs, 15 refs (In Czech)

Key Words: Shells, Cylindrical shells, Natural frequencies, Viscous damping

A method for computing the natural vibrations of a thin cylindrical shell with viscous structural damping is described. Relations between phase velocities of bending waves, natural frequencies, aerodynamic damping, global damping and the velocity of fluid flowing inside the shell are presented.

PIPES AND TUBES

(Also see No. 1795)

83-1815

Parameter Resonances of a Flown-Through Straight Pipe Supported on Two Rests (Parameterresonanzen des durchströmten geraden Rohres bei Lagerung als Zweistützträger)

O. Becker

Ingenieurhochschule Zittau, Maschinenbautechnik, 32 (2), pp 77-79 (Feb 1983) 4 figs, 8 refs
(In German)

Key Words: Pipes (tubes), Fluid-induced excitation

Velocity and pressure pulsation of fluid flowing through a pipe cause parameter-excited vibrations of the pipe. Approximation equations for the limiting curves of the main instability region for a pipe on two supports are given, which are valid for small pulsations.

83-1816

A Small Strouhal Number Analysis for Acoustic Wave-Jet Flow-Pipe Interaction

S.W. Rienstra
National Aerospace Lab. NLR, Amsterdam, The Netherlands, J. Sound Vib., 86 (4), pp 539-556 (Feb 22, 1983) 5 figs, 1 table, 28 refs

Key Words: Pipes (tubes), Elastic waves, Sound waves, Aircraft noise, Jet noise

Asymptotic expansions for small Strouhal number, valid for arbitrary subsonic Mach number, are derived for the solution of a simple problem of the interaction between an acoustic wave, a jet flow and a pipe. These expansions relate to the pressure and velocity fluctuations in the jet flow and in the far field, and to the reflection coefficient, end-impedance and end-correction for the reflected wave in the pipe. The field inside the flow is compared with experiments. The influence of a Kutta condition at the lip of the pipe is shown to be highly significant.

83-1817

Thermally Induced Acoustic Oscillations in a Pipe (3rd Report: Oscillations Induced by a Premixed Flame in a Pipe)

H. Madarame
Univ. of Tokyo, 7-3-1 Hongo Bunkyo-ku Tokyo, Japan, Bull. JSME, 26 (214), pp 603-610 (Apr 1983) 19 figs, 3 refs

Key Words: Pipes (tubes), Acoustic response, Vibration response, Temperature effects

Acoustic oscillations induced by a premixed flame in a pipe have been studied analytically and experimentally in comparison with the gauze tones which have been reported in previous papers.

83-1818

Turbulence Measurements in a Resonance Tube

K.H. Chou, P.S. Lee, and D.T. Shaw
Dept. of Mech. Engrg., Texas A&M Univ., College Station, TX 77843, J. Sound Vib., 86 (4), pp 475-483 (Feb 22, 1983) 8 figs, 1 table, 9 refs

Key Words: Tubes, Sound waves, Wave propagation, Turbulence

Experimental investigations of acoustically induced turbulence in a resonance tube are performed. Frequency and sound pressure level effects are studied and measurements are made at various spatial locations on loops and nodes. Sampled data are processed to estimate the characteristics of turbulence.

83-1819

Approach Flow Direction Effects on the Cross-Flow Induced Vibrations of a Square Array of Tubes

D.S. Weaver and H.C. Yeung
Dept. of Mech. Engrg., McMaster Univ., Hamilton, Ontario, Canada L8S 4L7, J. Sound Vib., 87 (3), pp 469-482 (Apr 8, 1983) 11 figs, 1 table, 24 refs

Key Words: Tube arrays, Fluid-induced excitation, Experimental test data

Water tunnel experiments were conducted on a square array of tubes with a pitch ratio of 1 5. The array could be rotated about an axis perpendicular to the direction of flow so that the effects of incident flow direction on cross-flow tube response could be studied. Constant Strouhal number vorticity response was observed over a range of orientations with some Strouhal number dependence on orientation angle.

DUCTS

83-1820
Acoustic Radiation Impedance of Duct-Nozzle System
M. Salikuddin and P. Mungur
Lockheed-Georgia Co., Marietta, GA 30063, J. Sound Vib., 86 (4), pp 497-522 (Feb 22, 1983) 17 figs, 20 refs

Key Words: Ducts, Nozzles, Sound propagation, Acoustic impedance

A method is described to evaluate the radiation impedance spectra of a duct-nozzle system with and without mean flow by using measured reflection coefficient data. The application of this method is described and results are presented to show the effect of nozzle geometry and the effect of mean flow on the radiation impedance of the duct-nozzle system.

83-1821
A Study on Mufflers with Air Flow (1st Report: Generation of Noise from Expansion Cavity Type Mufflers Due to Mean Flow)
M. Fukuda, N. Kojima, and T. Iwaishi
Yamaguchi Univ., Tokiwadai, Ube, Japan, Bull. JSME, 26 (214), pp 562-568 (Apr 1983) 16 figs, 2 tables, 16 refs

Key Words: Mufflers, Noise generation

This paper presents theoretical and experimental studies on the expansion cavity type mufflers with mean flow. It is shown that the inlet part of the tail pipe is a point of the largest flow noise generation inside the cavity of the muffler and a very large air flow noise is generated when a jet stream from the inlet pipe directly impacts the tail pipe.

BUILDING COMPONENTS

83-1822
Mechanical Behavior of Shear Wall Vertical Boundary Members: An Experimental Investigation
M.T. Wagner and V.V. Bertero
Earthquake Engrg. Res. Ctr., Univ. of California, Berkeley, CA, Rept. No. UCB/EERC-82/18, NSF/CEE-82067, 78 pp (Oct 1982)
PB83-159764

Key Words: Walls, Reinforced concrete, Seismic excitation

An experimental program has been formulated to examine the behavior of confined edge members in reinforced concrete wall systems subjected to seismic excitations. This report describes the design and construction of the testing facility required to conduct such a program and discusses the first series of experiments and results. Eight specially shaped concrete specimens were tested to assess the mechanical characteristics of edge members.

83-1823
Cracking and Shear Effects on Structural Walls
J.D. Aristizabal-Ochoa
Vanderbilt Univ., Nashville, TN 37235, ASCE J. Struc. Engrg., 109 (5), pp 1267-1277 (May 1983) 5 figs, 3 tables, 5 refs

Key Words: Walls, Reinforced concrete, Natural frequencies, Seismic design

A mathematical model taking into account flexural and shear deformation, rotary moment of inertia, and axial loads is developed to calculate the natural frequencies of isolated walls. Results of free vibration tests of nine 1/3-scale reinforced concrete isolated walls are evaluated using the mathematical model. Results of the free vibration tests are also compared with calculated frequencies using simplified formulas available in standard textbooks.

83-1824
Resonant Oscillations of Fluid-Loaded Struts
D.G. Crighton
Dept. of Appl. Mathematical Studies, Univ. of Leeds, Leeds LS2 9JT, UK, J. Sound Vib., 87 (3), pp 429-437 (Apr 8, 1983) 6 refs

Key Words: Struts, Cantilever beams, Fluid-induced excitation, Resonant response

A simplified model is used to obtain a description of the way in which radiation damping limits the resonant oscillations of a cantilever or strut. The pressure field near the strut is also examined.

83-1825

Investigation of Floor Vibrations in the 'D' Wing of the Main Building of the Bureau of Engraving and Printing

T.A. Reinhold, F.Y. Yokel, and F.F. Rudder

National Bureau of Standards, Washington, DC, Rept. No. NBSIR-82-2599, 40 pp (Dec 1982)

PB83-154187

Key Words: Floors, Mode shapes, Resonant frequencies, Displacement measurement, Printing

Floor vibrations induced by a recently-installed perforator were investigated by measuring relative acceleration amplitudes and phase relationships between a reference position and points on a grid laid out on the affected floor. From these measurements, it was possible to determine mode shapes, resonant frequencies and displacement amplitudes. On the basis of the displacement amplitudes, anticipated cyclic stresses in the structural system were estimated. The results of the measurements and analysis were compared with existing data on vibration-induced structural damage and fatigue strength of steel and reinforced concrete.

DYNAMIC ENVIRONMENT

ACOUSTIC EXCITATION

(Also see Nos. 1865, 1867, 1868, 1869, 1870, 1871, 1876, 1877)

83-1826

Expected Values of Sound Emission of Connecting-Rod Mechanisms of Textile Machinery (Erwartungswerte der Schallemission von Koppelgetrieben des Textilmaschinenbaues)

K. Butter

VEB Textimaforschung MALIMO Karl-Marx-Stadt, Maschinenbautechnik, 32 (2), pp 86-87 (Feb 1983) 1 ref

(In German)

Key Words: Machinery noise, Industrial facilities, Noise generation, Noise prediction

Statistically evaluated measurement data, taken on various textile machinery drive units, is used for the prediction of sound emission of connecting rod mechanisms. A regression equation is presented which takes into consideration the velocity, stroke, and the surface of the mechanism. Other parameters discussed are housing configuration, transfer functions and the crank-connecting rod ratios.

83-1827

Auxiliary Noise Control in Press Brings about a High Noise Level Reduction (Nachtragliches Schalldämmen an Umformpressen bringt hohe Pegelreduzierung)

H. Schilling

Maschinenmarkt, 89 (29), pp 632-634 (Apr 12, 1983) 7 figs

(In German)

Key Words: Noise reduction, Housings, Presses

Noise level in presses can be reduced by about 20-30 dB(A) by means of auxiliary closed housing. The results obtained depend on the frequency spectrum of the press, the noise components of input and output of stock, compressed air noise, and the mounting of noise protection housing. The individual elements of a properly assembled housing can be exchanged when damaged, or used in another machine.

83-1828

Experiments on High Bypass Internal Mixer Nozzle Jet Noise

J.H. Goodykoontz

NASA Lewis Res. Ctr., Cleveland, OH, Rept. No. E-1456, NASA-TM-83020, 23 pp (Dec 1982)

N83-16152

Key Words: Jet noise, Nozzles, Geometric effects

Model scale jet noise data are presented for a variety of internal lobed mixer nozzle configurations for take off power settings in a static environment. The results are presented for a 17.5 cm diameter fan nozzle to show the effect on noise levels caused by changes in geometric shape of the internal, or core flow, nozzle. The geometric variables include the lobe discharge angle, the number of lobes, spacing between the center plug and lobe valley, lobe side wall shape and axial contour of the lobes. An annular plug core flow nozzle was also tested and is used as a baseline for comparative purposes.

83-1829

Empirical Source Noise Prediction Method with Application to Subsonic Coaxial Jet Mixing Noise

W.E. Zorumski and D.S. Weir

NASA Langley Res. Ctr., Hampton, VA, Rept. No. L-15382, NASA-TP-2084, 77 pp (Dec 1982)
N83-16149

Key Words: Jet noise, Noise prediction

A general empirical method, developed for source noise predictions, uses tensor splines to represent the dependence of the acoustic field on frequency and direction and Taylor's series to represent the dependence on source state parameters. The method is applied to prediction of mixing noise from subsonic circular and coaxial jets. A noise data base of 1/3-octaveband sound pressure levels (SPL's) from 540 tests was gathered from three countries.

83-1830

Normal Mode Identification for Impedance Boundary Conditions

R.A. Koch, P.J. Vidmar, and J.B. Lindberg

Appl. Res. Labs., The Univ. of Texas at Austin, Austin, TX 78712-8029, J. Acoust. Soc. Amer., 73 (5), pp 1567-1570 (May 1983) 2 figs, 11 refs

Key Words: Underwater sound, Normal modes

A prescription is presented for identifying normal modes calculated using the plane-wave reflection coefficient (impedance condition) to represent bottom interaction. The new prescription reduces to the usual equality between mode number and number of eigenfunction zeros for a fluid layer over a homogeneous fluid bottom. For a more complex bottom composition, the mode number also has a contribution given by the number of times that, as a function of horizontal wavenumber, the reflection coefficient circles the origin in the complex plane.

SHOCK EXCITATION

(Also see Nos. 1725, 1863, 1864, 1925)

83-1831

Investigation of State of Stress in the Failing Bodies

J. Beneš and H. Šebková

Inst. of Thermomechanics, Czechoslovak Academy of Sciences, Prague, Czechoslovakia, Strojnícky Časopis, 34 (1-2), pp 277-288 (1983) 11 figs, 11 refs
(In Czech)

Key Words: Impact tests, Fracture properties

A hybrid experimentally-theoretical method to investigate the dynamic state of stress of elastic two-dimensional bodies is applied. The object of the research is to establish a suitable procedure for determination of fracture characteristic of material from impact tests on large specimens at such load increase and speeds of crack propagation, at which the state of stress in the specimen is influenced by the stress waves.

83-1832

Dynamic Analysis of the 75MM ADMAG Gun System

M.T. Soifer and R.S. Becker

S and D Dynamics, Inc., Huntington, NY, Rept. No. ARBRL-CR-00495, SBI-AD-F300 172, 346 pp (Dec 1982)
AD-A123 867

Key Words: Gunfire effects, Natural frequencies, Mode shapes, Finite element technique, Lumped parameter method

A detailed description of the finite element (lumped parameter) analytical simulation model of the 75mm ADMAG gun system, developed for the purpose of simulating the dynamic response of the physical system to single shot and burst mode firings, is presented. Model output consisting of natural frequencies, normal mode shapes and system response to a firing (including time-dependent trunnion and elevation link loads, and muzzle linear and angular displacements, velocities and accelerations) is presented.

83-1833

Design of Protective Structures Against Blast

S. Ginsburg and U. Kirsch

Cornell Univ., Ithaca, NY, ASCE J. Struc. Engrg., 109 (6), pp 1490-1506 (June 1983) 8 figs, 26 refs

Key Words: Protective shelters, Blast resistant structures

Some aspects of analysis and design of protective structures are discussed. It is demonstrated that parametric analyses can be used to obtain an approximate model for reanalysis. The latter describes the major phenomena involved in the problem; i.e., those that most influence the design variables. Examples are used to describe the approximations, and an optimization approach is suggested. The suggested design process is based on a multilevel scheme involving a few separate design spaces, each of which contains a class of variables of the same type.

83-1834

Time-Domain Study of Tectonic Strain-Release Effects on Seismic Waves from Underground Nuclear Explosions

K.K. Nakanishi and N.W. Sherman
Lawrence Livermore Natl. Lab., CA, Rept. No. UCRL-53321, 30 pp (Sept 1982)
DE83002610

Key Words: Explosions, Nuclear explosions, Underground explosions, Time domain method, Seismic waves, Wave propagation

Tectonic strain release affects both the amplitude and phase of seismic waves from underground nuclear explosions. Surface wave magnitudes are strongly affected by the component of tectonic strain release in the explosion. Amplitudes and radiation patterns of surface waves from explosions with even small tectonic components change magnitudes significantly and show a strong dependence on receiver locations. A thrust-slip source superimposed on an isotropic explosion can explain observed reversals in waveform at different azimuths and phase delays between normal and reversed Rayleigh waves.

VIBRATION EXCITATION

(Also see Nos. 1862, 1922)

83-1835

A Universal Strouhal Law

E. Levi
Instituto de Ingenieria, Universidad Nacional Autonoma de Mexico, 04510 Mexico, D.F., Mexico, ASCE J. Engrg. Mech., 109 (3), pp 718-727 (June 1983) 1 fig, 35 refs

Key Words: Fluid-induced excitation, Strouhal number

A universal relationship between the frequency of oscillation induced in a restrained fluid body by an external free flow, the velocity of the latter, and a typical width of the body, is established. Evidence is offered of the accuracy of this Strouhal law in such phenomena as wing autorotation, intermittent formation of vortices behind weirs and orifices, jet flapping and puffing, wake vortex shedding, oscillation of shock waves, cavitation bubbles and vortex breakdowns.

83-1836

Subharmonic Oscillations of a Mixing Layer-Wedge System Associated with Free Surface Effects

S. Ziada and D. Rockwell
Laboratories for Vibrations and Acoustics, Sulzer Brothers, Winterhur, Switzerland, J. Sound Vib., 87 (3), pp 483-491 (Apr 8, 1983) 8 figs, 5 refs

Key Words: Fluid-induced excitation, Subharmonic oscillations, Wedges

An unstable mixing layer, in conjunction with free surface wave effects, can give rise to well-defined subharmonic oscillations of the vortex shedding frequency provided certain streamwise phase conditions are satisfied. Visualization of these oscillations, forces acting on the impingement edge, and streamwise evolution of velocity spectra are addressed.

83-1837

Numerical Determination of Dynamic Stability Parameters and Periodic Vibrations of Plane Mechanisms (Numerische Bestimmung der Dynamischen Stabilitäts-Parameter und Periodischen Schwingungen Ebener Mechanismen)

N. Van Khang
Polytechnic Inst. of Hanoi, Vietnam, Rev. Roumaine Sci. Tech., Mecanique Appl., 27 (4), pp 495-507 (1982) 5 figs, 3 tables, 18 refs
(In German)

Key Words: Periodic response, Parametric vibration, Numerical analysis

The differential equations of parametrically excited vibrations of plane mechanisms with multi degrees of freedom are described. A numerical method for the determination of dynamic stability parameters and periodic vibrations of plane mechanisms by means of electronic calculation method is presented.

83-1838

Sensitivity Analysis for Problems of Dynamic Stability

P. Pedersen and A.P. Seyranian
Dept. of Solid Mechanics, The Technical Univ. of Denmark, Lyngby, Denmark, Intl. J. Solids Struc., 19 (4), pp 315-355 (1983) 12 figs, 3 tables, 24 refs

Key Words: Dynamic stability, Flutter

In mechanics, as well as in physics, the most general and important thing is to study the dependence of the charac-

teristics of a physical process on problem parameters. Problems of dynamic stability for non-conservative systems involve determination of eigenvalues and eigenvectors. For these problems it is shown in general how the different sensitivity analyses can be performed without any new eigenvalue analyses.

83-1839

General Procedure for the Response of Dynamic Systems

M. Di Paola

Facolta di Ingegneria, Universita' di Palermo, I 90128 Palermo, Italy, Rev. Roumaine Sci. Tech., Mecanique Appl., 27 (6), pp 697-705 (Nov/Dec 1982) 2 figs, 7 refs

Key Words: Random excitation, Time-dependent excitation

A general approach is presented to evaluate the response of dynamic systems subject to deterministic or random input. The initial approach is a step-by-step procedure from which we obtain a differential equation which defines the time variation of a dynamic system. Two examples are developed, for which stability and accuracy of step-by-step method are discussed in detail, and compared with other methods.

83-1840

Interactions Between Dynamic Normal and Frictional Forces During Unlubricated Sliding

A. Soom and C. Kim

State Univ. of New York at Buffalo, Buffalo, NY 14260, J. Lubric. Tech., Trans. ASME, 105 (2), pp 221-229 (Apr 1983) 19 figs, 10 refs

Key Words: Sliding friction, Friction excitation, Experimental test data

The results of measurements showing large normal and frictional force oscillations during unlubricated smooth sliding between steel surfaces are presented. The measurements were made on a pin-on disk type apparatus instrumented with piezoelectric force and acceleration transducers. Spectral analysis of the contact forces (including inertia forces) up to frequencies of 2 kHz indicate that the fluctuations have their major components in this frequency range.

83-1841

Experimental Investigation of the Effect of System Rigidity on Wear and Friction-Induced Vibrations

V. Aronov, A.F. D'Souza, S. Kalpakjian, and I. Shareef

Illinois Inst. of Tech., Chicago, IL 60616, J. Lubric. Tech., Trans. ASME, 105 (2), pp 206-209 (Apr 1983) 8 figs, 12 refs

Key Words: Self-excited vibration, Friction excitation, Experimental test data, Sliding friction

This paper presents experimental data and a physical model of the effects of normal load and system rigidity on the friction and wear processes with water lubrication. The transition from mild to severe friction and wear was found to be independent of the system rigidity, but dependent on the normal load. As the normal load is increased further, it reaches another critical value, which depends on the system rigidity, at which high frequency self-excited vibrations are generated.

83-1842

Free Vibrations of a Piezoelectric Layer of Hexagonal (6mm) Class

H.S. Paul, D.P. Raju, and T.R. Balakrishnan

Indian Inst. of Tech., Madras-600 036, India, Intl. J. Engrg. Sci., 21 (6), pp 691-704 (1983) 2 figs, 1 table, 11 refs

Key Words: Piezoelectricity, Plates, Free vibration

An asymptotic method due to Achenbach is used to analyze the free vibrations of a piezoelectric layer of hexagonal (6mm) class. In this method the displacement components, the electric potential and the frequency are expressed as power series of the dimensionless wavenumber $\epsilon = 2\pi$ x layer thickness/wavelength. Substituting the expansions of field variables and the frequency in the field equations of piezoelectricity and in the boundary conditions, a system of coupled, second order, inhomogeneous, ordinary differential equations with thickness variable as the independent variable is obtained.

83-1843

Jump Phenomenon and Its Absence in Nonlinear Hysteretic and Viscoelastic Oscillators

C-C.W. Tu

Ph.D. Thesis, Univ. of Arkansas, 168 pp (1982)
DA8305129

Key Words: Periodic excitation, Hysteretic damping, Viscoelastic properties

Nonlinear oscillators containing hysteretic and viscoelastic models as their restoring mechanisms and subjected to sinusoidal excitations are examined. The aim of the study is to determine the bifurcation of the presence and the absence of the phenomenon of sudden jumps in the steady-state amplitude of the nonlinear systems when the forcing frequency or the forcing level is gradually varied. Results of the study reveal several salient features.

83-1844

Analysis of Forced Vibration by Reduced Impedance Method (Part 3. Damped Vibration)

A. Nagamatsu and A. Nakao
Tokyo Inst. of Tech., 2-12-1 Ohokayama Meguro-ku, Tokyo, Japan, Bull. JSME, 26 (214), pp 592-597 (Apr 1983) 19 figs, 2 tables, 15 refs

Key Words: Forced vibration, Resonant frequencies, Modal damping, Impedance technique

Two methods are proposed to analyze the damped vibration of mechanical structures by a reduced impedance method (RIM) when a modal damping ratio or a frequency spectrum of the damping coefficient is given. Modal damping ratios of simple specimens are obtained experimentally by the technique of curve fitting. The frequency spectra of responses of damped vibration are analyzed by the real RIM with modal damping ratios.

83-1845

Analysis of Forced Vibration by Reduced Impedance Method (Part 4. Proposition and Application of Multiple Reduced Impedance Method)

A. Nagamatsu, M. Ookuma, Y. Fujita, T. Ikeuchi, and M. Shirai
Tokyo Inst. of Tech., 2-12-1 Ohokayama Meguro-ku, Tokyo, Japan, Bull. JSME, 26 (214), pp 598-602 (Apr 1983) 9 figs, 7 refs

Key Words: Impedance technique, Forced vibration, Supports, Generators

A multiple reduced impedance method (MRIM) is proposed as an advanced type of the reduced impedance method (RIM) for analyzing the vibration of a mechanical structure so complex that the usual methods, for example the finite element method, cannot be applied directly on it. The natural frequency, natural mode and dynamic response of the supporting base of a diesel generator package are analyzed by MRIM.

MECHANICAL PROPERTIES

DAMPING

(Also see Nos. 1703, 1755)

83-1846

Overdamping of a Linear Mechanical System

D.W. Nicholson
Explosion Damage Branch, Naval Surface Weapons Ctr., White Oak, Silver Spring, MD 20910, Mech. Res. Comm., 10 (2), pp 67-76 (Mar/Apr 1983) 8 refs

Key Words: Damping, Linear systems

Necessary and sufficient conditions involving two positive Hermitian matrices, P and Q, are developed which are needed for a mechanical system to be overdamped. A formal solution for P is presented using a limiting argument.

83-1847

Understanding Damping Techniques for Noise and Vibration Control

D.T. Lilley
E-A-R Div., Cabot Corp., Indianapolis, IN, Plant Engrg., pp 38-40 (Apr 28, 1983) 6 figs

Key Words: Damping, Noise reduction, Vibration control

Effective control of noise and vibration in industrial plants usually requires several techniques, each of which contributes to a quieter environment. For most applications, noise and vibration control methods can be segregated into five classes: structural modification, absorption, use of barriers and enclosures, structural damping, and vibration isolation. Discussion in this article is limited to structural damping and damped vibration isolation.

83-1848

Mechanical Analysis of Active Vibration Damping in Continuous Structures

E. Luzzato and M. Jean

Applied Res. Lab., Pennsylvania State Univ., State College, PA 16801, J. Sound Vib., 86 (4), pp 455-473 (Feb 22, 1983) 5 figs, 4 tables, 20 refs

Key Words: Vibration damping, Active damping, Viscoelastic media

The aim of this work is to solve problems of active damping of vibrations in some given domain of a continuous viscoelastic structure. A mathematical model of the mechanical system, the sources of perturbing vibrations, the control system, and the different absorption criteria to be compared are defined. The problems are set in infinite dimension spaces, and the approximate problems are derived in finite dimension spaces. Two methods of resolution are proposed and the solutions are compared.

83-1849

Semi-Active Versus Passive or Active Tuned Mass Dampers for Structural Control

D. Hrovat, P. Barak, and M. Rabins

Ford Motor Co., Dearborn, MI, ASCE J. Engrg. Mech., 109 (3), pp 691-705 (June 1983) 8 figs, 3 tables, 9 refs

Key Words: Active damping, Dynamic vibration absorption (equipment), Buildings, Wind-induced excitation

A semi-active tuned mass damper (TMD) is proposed to control wind induced vibrations in tall buildings. The semi-active TMD uses a small amount of external power to modulate the damping. The net result is the equivalent of a passive TMD with hydraulically controlled time-varying characteristics. Simulation studies show the proposed system is superior to conventional passively controlled and comparable to actively controlled systems.

83-1850

Optimum Design of a First Story Damping System

M.C. Constantinou and I.G. Tadjbakhsh

Rensselaer Polytechnic Inst., Troy, NY 12181, Computers Struc., 17 (2), pp 305-310 (1983) 4 figs, 1 table, 14 refs

Key Words: Dampers, Optimum design, Buildings, Multistory buildings

The optimum design of a first story damping system of multistory shear type structures is considered. Analytical expressions, for the case of stationary white noise ground accelerations, are derived for maximum displacements of each floor. Based on these, suitable objective functions are defined. Parametric study for the determination of the effect of structural damping and structure's flexibility on the control quantities is performed and the optimal design of several structures is carried out.

83-1851

Critical Damping in Certain Linear Continuous Dynamic Systems

B.A. Boley

Technological Inst., Northwestern Univ., Evanston, IL, Rept. No. TR-1982-1, 13 pp (Oct 1982) AD-A124 113

Key Words: Critical damping, Beams, Fiber composites, Layered materials

The most commonly used formulas for the analysis of fiber-reinforced and laminated beams are those given by the familiar law of mixtures. In their most general form, these formulas are derived by the methods of elementary strength-of-materials theory, on the basis of the Bernoulli-Euler assumptions. In general, of course, these formulas are only approximate. Because of their simplicity, however, it is desirable to use them whenever one may do so with sufficient accuracy. It is therefore the purpose of the present work to examine the validity of the simple formulas, and to determine how, and when, they should be corrected.

FATIGUE

(Also see Nos. 1769, 1780, 1784)

83-1852

A Pitting Model for Rolling Contact Fatigue

L.M. Keer and M.D. Bryant

Northwestern Univ., Evanston, IL 60201, J. Lubric. Tech., Trans. ASME, 105 (2), pp 198-205 (Apr 1983) 7 figs, 20 refs

Key Words: Fatigue life, Rolling friction

The interaction of a Hertzian contact, including friction, with an angled surface-breaking crack is studied with a view toward qualitatively explaining certain aspects of rolling contact fatigue. Cyclic loading and unloading of the surface

crack, which is assumed to be embedded in a rolling wheel, *is simulated by assuming that stresses having a Hertzian* distribution travel across the half space such that one passage is equivalent to one cycle of rolling. By increasing the crack's length and calculating the stress intensity factor, an estimate of the fatigue life can be determined.

83-1853

Fretting Wear and Fretting Fatigue -- How are They Related?

R.C. Bill

Propulsion Lab., AVRADCOM Res. and Tech. Labs., Lewis Res. Ctr., Cleveland, OH, J. Lubric. Tech., Trans. ASME, 105 (2), pp 230-238 (Apr 1983) 15 figs, 28 refs

Key Words: Fatigue life

Results from published literature and results obtained by the author are examined in detail to determine how fretting wear and fretting fatigue are related. The effects of various experimental parameters, including slip amplitude, number of fretting cycles, frequency of fretting motion, experimental atmosphere, temperature, and the performance of coatings and surface treatments, are surveyed.

83-1854

Fatigue Strength of Steel Pipe-Base Plate Connections

J.W. Fisher, C. Miki, R.G. Slutter, D.R. Mertz, and W. Frank

Fritz Engrg. Lab., Lehigh Univ., Bethlehem, PA 18015, Engrg. Struc., 5 (2), pp 90-96 (Apr 1983) 10 figs, 5 refs

Key Words: Fatigue tests, Joints (junctions)

The comparative fatigue resistance of two types of steel light poles is investigated both experimentally and analytically. The constant amplitude fatigue behavior was obtained at several levels of stress range. Exposed fatigue crack surfaces were studied to ascertain the nature of the crack initiation and propagation. Theoretical fatigue life estimates were also made using an existing fracture mechanics model, thought to simulate the geometric condition represented by the welded pipe-base plate connection.

83-1855

Specimens and Test Equipment for Economical Fatigue Threshold Testing

A.F. Blom, J. Baecklund, and L. Jilken

Aeronautical Res. Inst. of Sweden, Stockholm, Sweden, Rept. No. FFA-TN-1982-28, 23 pp (Aug 1982) (Presented at 1st Intl. Conf. on Fatigue Thresholds, Stockholm, June 1-3, 1981)

N83-14548

Key Words: Fatigue tests, Test equipment and instrumentation

Experimental procedures for the determination of the fatigue threshold stress intensity factor are discussed. An automatic method which is time and cost effective is presented. The method is of a stress intensity factor decreasing type and uses a mixed load/deformation control procedure which allows the load ratio to be kept constant throughout the test without the aid of a computer.

83-1856

Fretting Fatigue of Cast-Iron Materials (Schwingungsrisskorrosion von Eisengusswerkstoffen)

J. Lenk

Institut f. Leichtbau Dresden, German Dem. Rep., Maschinenbautechnik, 32 (2), pp 87-89 (Feb 1983) 7 figs, 1 table, 3 refs

(In German)

Key Words: Fretting corrosion, Fatigue life

The effect of corrosive media on fatigue strength of cast iron with spheroidal graphite, malleable cast iron, as well as modified cast iron with laminated graphite, is investigated.

ELASTICITY AND PLASTICITY

83-1857

Diffraction of Plane Harmonic Waves by Cracks

K. Takakuda

Tokyo Inst. of Tech., Tokyo, Japan, Bull. JSME, 26 (214), pp 487-493 (Apr 1983) 6 figs, 1 table, 11 refs

Key Words: Boundary value problems, Cracked media, Elastic properties, Harmonic waves

The general steady-state dynamic boundary value problems of elastic bodies with cracks are formulated in the form of integro-differential equations. The equations for plane problems are worked out in detail. Several numerical calculations are carried out.

WAVE PROPAGATION

83-1858

Radiation and Attenuation of Low- and High-Frequency Waves in a Random Medium

A.R. Wenzel

Naval Ocean Res. and Dev. Activity, Code 340, NSTL Station, MS 39529, Wave Motion, 5 (3), pp 215-223 (June 1983) 5 refs

Key Words: Wave propagation, Wave attenuation

The wave field radiated by a point source in a weakly inhomogeneous, weakly dissipative, one-dimensional random medium is considered. Approximate expressions for the mean intensity and mean energy flux as a function of propagation range, based on general results obtained previously, are derived for the limiting cases of low and high frequencies.

83-1859

Summation of Gaussian Beams in a Surface Waveguide

V.E. Grikurov and M.M. Popov

V.A. Steklov Mathematical Inst., Academy of Sciences of the USSR, Leningrad Branch, Leningrad 191011, USSR, Wave Motion, 5 (3), pp 225-233 (June 1983) 4 figs, 11 refs

Key Words: Wave propagation, Waveguide analysis

The Gaussian beams summation method is applied to a surface waveguide problem in the parabolic approximation. It is shown by means of numerical comparison with an exact solution that the method is effective for computations.

83-1860

On the Convergence of the Time-Domain Bremmer Series

S.H. Gray

Amoco Production Co., P.O. Box 591, Tulsa, OK 74102, Wave Motion, 5 (3), pp 249-255 (June 1983) 8 refs

Key Words: Wave propagation, Time domain method

The frequency-dependent Bremmer series for wave propagation in a plane stratified medium is studied. It is known that the series converges if the variations in the medium are not too large. Less well-known is the fact that the series is more likely to converge in a medium with large variations if the frequency of the incident wave is high rather than low. It is shown that if the variations in the medium remain finite, a frequency-independent (Fourier transformed) version of the series converges.

83-1861

Theoretical Analysis of Wave Energy Converter Consisting of Three Floating Bodies

R. Kawatani and M. Masubuchi

Osaka Univ., 2-1, Yamada-oka, Suita-shi, Osaka, Japan, Bull. JSME, 26 (214), pp 667-674 (Apr 1983) 5 figs, 5 tables, 14 refs

Key Words: Wave forces, Energy conversion

A theoretical analysis of a wave energy converter consisting of three floating bodies, connected by links and oscillating subject to a sinusoidal wave, is presented. By taking into account radiation and diffraction problems on an n body system using the relation of Haskind, governing equations for a three body system are obtained under the constraint of links. System parameters such as body distance, configuration of the body, and coefficient of viscous damping have been optimized to get maximum energy converting efficiency for symmetrical and asymmetrical arrangements.

83-1862

An Experimental Investigation of Pass Bands and Stop Bands in Two Periodic Particulate Composites

V.K. Kinra and E.L. Ker

Aerospace Engrg. Dept., Texas A&M Univ., College Station, TX 77843, Intl. J. Solids Struc., 19 (5), pp 393-410 (1983)

Key Words: Composite materials, Wave propagation, Periodic excitation

An important property of the periodic composites is that the dispersion curve is characterized by pass bands and stop bands. In the past these have been demonstrated, analytically and experimentally, for layered and fibrous composites. The purpose of the present experimental investigation is to show that the same phenomena exist in periodic particulate composites.

83-1863

Effect of Low Loading Density on Blast Propagation from Earth Covered Magazines

C. Kinery and G. Coulter
Ballistic Res. Lab., Army Armament Res. and Dev. Command, Aberdeen Proving Ground, MD, Rept. No. ARBRL-TR-02453, SBI-AD-F300 161, 111 pp (Dec 1982)
AD-A123 333

Key Words: Shock wave propagation, Air blast

This report contains the results from a series of high explosive tests designed to determine the airblast parameters propagating to the front, side, and rear of an earth covered munition storage magazine with a low loading density. The tests were conducted with 1/30th-scale donar models and hemi-cylindrical pentolite charges of 0.227, 0.363, 1.088, 1.814, and 5.040 kg masses. These charge masses simulate full size munition storage magazines filled with 6,130, 9,800, 29,370, 48,980, and 136,080 kg of explosive.

83-1864

Ground Motion Amplification Due to Elastic Inclusions in a Half-Space

M. Dravinski
Dept. of Mech. Engrg., Univ. of Southern California, Los Angeles, CA, Intl. J. Earthquake Engrg. Struc. Dynam., 11 (3), pp 313-335 (May/June 1983) 15 figs, 20 refs

Key Words: Wave diffraction, Inclusion, Discontinuity containing media, Elastic half-space, Ground motion, Seismic excitation

Scattering of plane harmonic SH, P, SV and Rayleigh waves by several inclusions of arbitrary shape, completely embedded into an elastic half-space, is considered. Perfect bonding between the half-space and the inclusions is assumed. The problem is investigated for linear, isotropic and homogeneous elastic materials. The displacement field is evaluated throughout the elastic medium so that the continuity conditions between the half-space and the inclusions are satisfied in mean-square sense. Numerical results of the surface displacement field are evaluated for single and two elliptic inclusions.

83-1865

Diffraction of an Elastic Wave by an Embedded Quarter-Space

J.A. Hudson
Dept. of Appl. Mathematics and Theoretical Physics, Univ. of Cambridge, Cambridge CB3 9EW, UK, Wave Motion, 5 (3), pp 185-195 (June 1983) 2 figs, 8 refs

Key Words: Wave diffraction, Elastic waves

A method of matching asymptotic fields has recently been applied to the problem of the diffraction of a plane time-harmonic acoustic wave by an embedded quarter-space with different acoustic properties from the rest of space. The method is here applied to the equivalent problem of elastic waves. The normal to the incident wavefront is perpendicular to the apex of the quarter-space and so the problem is two-dimensional in plane strain. Exact expressions are found for the far-field on the boundary of the quarter-space, neglecting those terms which decay faster than the inverse half power of the distance. The main case of interest is where the incident wave propagates parallel to one of the interfaces.

83-1866

Refraction Effects in the Generation of Helical Surface Waves on a Cylindrical Obstacle

A. Nagl, H. Uberall, P.P. DelSanto, J.D. Alemar, and E. Rosario
Dept. of Physics, Catholic Univ. of America, Washington, DC 20064, Wave Motion, 5 (3), pp 235-247 (June 1983) 2 figs, 15 refs

Key Words: Wave diffraction, Cylinders

The scattering of compressional waves from an infinite, circular-cylindrical obstacle, and the excitation during the scattering process of surface waves that propagate along helical paths over the cylinder surface is investigated. For the case of a rigid or soft obstacle, the surface waves are external, and are obtained via the use of a Watson transformation. For the case of a penetrable cylinder, additional internal, resonant surface waves are generated for which the phase and group velocity dispersion curves can be obtained from the Resonance Scattering Theory. A detailed study of certain refraction effects which take place upon the generation of the surface waves by the incident plane wave is performed.

83-1867

Acoustic Resonance Scattering by a Penetrable Cylinder

D. Brill and G.C. Gaunaurd

U.S. Naval Academy, Annapolis, MD 21402, J. Acoust. Soc. Amer., 73 (5), pp 1448-1455 (May 1983) 9 figs, 25 refs

Key Words: Acoustic scattering, Cylinders

Although sound scattering by submerged elastic cylinders has been the subject of many papers, it was only recently that this and similar problems have been examined in the light of the resonance scattering theory (RST). Crucial experiments have been performed recently in which the modal resonances contained within the cylinder's backscattering cross section were isolated by means of a background subtraction, experimentally accomplished by a clever time-gating technique. In this paper a variety of tailor-made calculations and graphical displays required to thoroughly examine those experiments in the light of the RST are generated. For the same cylinder, liquids, and frequency ranges of interest many spectral graphs are produced displaying all the modal resonances that combine with the modal backgrounds to produce the observed and/or predicted cross sections.

83-1868

Solution of Acoustic Scattering Problems by Means of Second Kind Integral Equations

V. Rokhlin

Exxon Production Res. Co., P.O. Box 2189, Houston, TX 77001, Wave Motion, 5 (3), pp 257-272 (June 1983) 5 figs, 32 refs

Key Words: Acoustic scattering, Sound waves

The problem of scattering of acoustic waves from a fluid inclusion in two dimensions is solved numerically. The boundary conditions are those of continuous pressure and normal displacement. The integral equations of the present paper possess a very simple physical interpretation which guarantees the stability of their numerical solution and rapid convergence of the iterative solver. The resulting algorithm is an efficient tool for solving relatively large scale two-dimensional scattering problems.

83-1869

Low-Frequency Acoustic Diffraction by a Soft Elliptic Disk

A. Roy and F.J. Sabina

Instituto de Investigaciones en Matemáticas, Aplicadas y en Sistemas, Universidad Nacional Autonoma de Mexico, Apartado Postal 20-726, 01000 Mexico, D.F., Mexico, J. Acoust. Soc. Amer., 73 (5), pp 1494-1498 (May 1983) 1 fig, 8 refs

Key Words: Acoustic scattering, Disks

The problem of the diffraction of an arbitrary incident plane sound wave by a soft-sound elliptic disk is studied. A Fredholm integral equation of the first class is posed and solved explicitly in the low-frequency limit. The solution is new and expressions for the farfield amplitude and the scattering cross section are obtained to the same order.

83-1870

Finite Element Eigenfunction Method (FEEM) for Elastic (SH) Wave Scattering

J.H. Su, V.V. Varadan, and V.K. Varadan

Wave Propagation Group, Dept. of Engrg. Mechanics, Ohio State Univ., Columbus, OH 43210, J. Acoust. Soc. Amer., 73 (5), pp 1499-1504 (May 1983) 13 figs, 8 refs

Key Words: Acoustic scattering, Cylinders, Finite element technique

A finite element eigenfunction method is presented for elastic wave scattering by cylinders of arbitrary cross section. The problem has been analyzed by enclosing the scatterer within an imaginary circular cylinder. The scattered field outside the circular cylinder is expanded in the usual cylindrical harmonics. The nearfield solution inside the circular cylinder is also assumed to be expanded by a series of eigenfunctions. The eigenfunctions for the nearfield are generated through the standard finite element technique by imposing suitable conditions on the circle. Both the coefficients of the scattered field and those of the nearfield are found by means of a least-square fit for the continuity conditions across the circle. The solution obtained thereby is considered complete in the sense that both the scattered and the nearfields are solved simultaneously.

83-1871

Resonance Reflection of Acoustic Waves by a Perforated Bilaminar Rubber Coating Model

P.D. Jackins and G.C. Gaunaurd

Naval Surface Weapons Ctr., White Oak, Silver Spring,

MD 20910, J. Acoust. Soc. Amer., 73 (5), pp 1456-1463 (May 1983) 4 figs, 2 tables, 17 refs

Key Words: Acoustic scattering, Elastomers

The prediction of the resonance scattering theory (RST) for the reflection of sound waves by a bilaminar rubber configuration separating two dissimilar semi-infinite acoustic media is constructed. The layers are further assumed to contain distributions of spherical air-filled perforations, of various concentrations in each layer, whose behavior is governed by a simple, static, effective parameter model. The direct scattering prediction of the RST is compared to that of the exact solution in order to show the usefulness of the RST to yield clear physical interpretations of complex phenomena. The casting of the direct scattering solution in RST-form also provides a systematic method to solve the inverse scattering problem for the composition of the bilaminar rubber configuration.

83-1873

A Frequency-Domain Procedure for the Identification of Time-Series Models

M.J. Sampson

Ph.D. Thesis, Queen's Univ. of Kingston, Canada (1982)

Key Words: Frequency domain method

A frequency domain procedure for the identification of time series models is developed. The basic approach is to examine the determinant of a matrix of weighted differences of the gain function. This is similar to Tintner's variate difference technique for determining the degree of a polynomial by repeated differencing. The theoretical advantage of this procedure over time domain identification is that it is capable of identifying mixed transfer functions and multivariate time series models with correlated inputs.

EXPERIMENTATION

MEASUREMENT AND ANALYSIS

(Also see Nos. 1887, 1888)

83-1872

Fast Convergence Modal Analysis for Continuous Systems

A.Y.T. Leung

Dept. of Civil Engrg., Univ. of Hong Kong, Hong Kong, J. Sound Vib., 87 (3), pp 449-467 (Apr 8, 1983) 6 figs, 7 tables, 6 refs

Key Words: Modal analysis, Continuous systems

A continuous system has an infinite number of degrees of freedom (n.d.o.f.) in a dynamic analysis. The dynamic stiffness method is able to produce an infinite number of natural modes with use of only a finite number of co-ordinates. The associated modal analysis is the only widely applicable approximate method for computing the response without discretizing the continuous system by methods such as the finite element method, in which the infinite n.d.o.f. is not retained. However, this modal analysis converges very slowly as the number of modes is increased if the loading distribution does not follow the patterns of the first few modes. A method is suggested in this paper to accelerate the convergence.

83-1874

System Analysis and Time Delay Spectrometry (Part 1)

H. Biering and O.Z. Pedersen

Bruel & Kjaer Instruments, Inc., Marlborough, MA 01752, Tech. Rev., 1, pp 3-51 (1983) 4 figs, 6 refs

Key Words: System analysis, Time delay spectrometry, Time domain method

Time delay spectrometry (TDS) is a relatively new method for measurement of system response. Based on a linear sine sweep it optimizes measurement performance eliminating some earlier drawbacks of swept measurements. By its very nature this method tempts us to adopt an identical complex description in the time and frequency domains. To fully utilize the benefits from this description it is essential to consider the general behavior of two-port systems and the problems encountered in the measurement of these systems. This article gives an overview of the theoretical foundation for analysis of linear and time invariant systems.

83-1875

Ultrasonic Signal Distortion and Its Effects on Velocity Measurements in Dispersive Constant-Group-Velocity Media

P.L. Edwards

Naval Surface Weapons Ctr., Silver Spring, MD 20910, J. Acoust. Soc. Amer., 73 (5), pp 1608-1615 (May 1983) 9 figs, 4 refs

Key Words: Pulse excitation, Ultrasonic techniques, Wave propagation

Results are presented of calculations made of distortion experienced by ultrasonic pulses in transmission through dispersive constant-group-velocity media, and the effects that it may have on velocity measurements. Three types of pulses were considered: a pulsed sine wave of constant amplitude, a pulsed sine wave with amplitude varying as sine-squared, and a rectangular pulse.

83-1876

Methods and Possibilities for the Determination of the Power Radiated by an Acoustic Source. Part 1. Survey about the Traditional Methods for Estimating the Sound Power (Methoden und Möglichkeiten zur Bestimmung der abgestrahlten Schalleistung. Teil 1. Überblick über die derzeit benutzten Verfahren zur Bestimmung der Schalleistung)

I. Veit

Fraunhofer-Institut fur Bauphysik, D-7000 Stuttgart 70, Fed. Rep. Germany, Techn. Messen-TM, 50 (3), pp 87-92 (Apr 1983) 6 figs, 19 refs

(In German)

Key Words: Sound measurement, Measurement techniques, Sound power levels

The pressure amplitude measured near a source clearly depends on both the distance between source and measuring point and on the acoustic properties of the environment that surrounds the source. Practical test conditions thus have to be taken into careful account in estimating the radiated power from measurements of the pressure. In this paper some new techniques for estimating the radiated power are discussed following a review of more traditional methods.

83-1877

Methods and Possibilities for the Determination of the Power Radiated by an Acoustic Source. Part 2. Determination of the Sound Power from Measurement of the Sound Intensity; Phase-Gradient Method (Methoden und Möglichkeiten zur Bestimmung der abgestrahlten Schalleistung. Teil 2. Schalleistungsbestimmund durch Messung der Schallintensität; Phasengradienten-Methode)

I. Veit

Fraunhofer-Institut fur Bauphysik, 7000 Stuttgart 70, Fed. Rep. Germany, Techn. Messen-TM, 50 (4), pp 151-154 (Apr 1983) 9 figs, 34 refs

(In German)

Key Words: Sound measurement, Measurement techniques, Sound power levels

The pressure amplitude measured near a source clearly depends on both the distance between source and measuring point and on the acoustic properties of the environment that surrounds the source. Practical test conditions thus have to be taken into careful account in estimating the radiated power from measurements of the pressure. In this paper some new techniques for estimating the radiated power are discussed following a review of more traditional methods.

83-1878

Holographic Analysis of Large Vehicle Structures

G.R. Gerhart, G. Arutunian, and J.M. Graziano

Army Tank-Automotive Command, Warren, MI, Rept. No. TACOM-TR-12595, 100 pp (July 1982) AD-A124 102

Key Words: Vibration analysis, Holographic techniques, Ground vehicles

A highly tuned, double pulse, Q-switched ruby laser is used to make double exposure holograms of large vibrating objects. The holographic fringe patterns are interpreted to produce a detailed knowledge of the displacement amplitude for a wide variety of vibrating objects. A triggering system permits the firing of the laser relative to arbitrary phase orientations of the vibrating object. A primary emphasis is placed upon the holograms at the same amplitude and frequency but different phase angles yields valuable information about the dynamics of the vibrating vehicle components. These interferometric fringe patterns reveal important information about global displacement amplitude and stress concentrations.

83-1879

Introduction to Acoustic Emission (Introduzione All'Emissione Acustica)

G. Possa

Centro Informazioni Studi Esperienze, Milan, Italy, Rept. No. CISE-1792, 5 pp (1982)

N83-15051

(In Italian)

Key Words: Acoustic emission, Signal processing techniques, Noise source identification

Typical acoustic emission signal characteristics are described and techniques which localize the signal source by processing the acoustic delay data from multiple sensors are discussed. The instrumentation, which includes sensors, amplifiers, pulse counters, a minicomputer and output devices is examined. Applications are reviewed.

83-1880

Spectral Analysis Algorithms for the Laser Velocimeter: A Comparative Study

W.A. Bell

Lockheed-Georgia Co., Marietta, GA, AIAA J., 21 (5), pp 714-719 (May 1983) 9 figs, 2 tables, 18 refs

Key Words: Spectrum analysis, Velocity measurement, Lasers

Conventional methods of computing spectra require constant sampling rates and therefore must be modified to accommodate the randomly sampled data from the laser velocimeter. Four approaches that provide estimates of the power spectra from randomly sampled data are evaluated with respect to accuracy and computational speed. Simulated data of varying spectral content are used as input. An estimate of the correlation function that resolves the random time distribution into equidistant time intervals provides the best compromise between computational speed and accuracy for laser velocimeter data.

83-1881

Measurement of Vibration Velocity Distributions and Mode Analysis in Thick Disks of $Pb(Zr{\cdot}Ti)O_3$

S. Ueha, S. Sakuma, and E.Mori

Res. Lab. of Precision Machinery and Electronics, Tokyo Inst. of Tech., 4259 Nagatsuta, Midori-ku, Yokohama 227, Japan, J. Acoust. Soc. Amer., 73 (5), pp 1842-1847 (May 1983) 10 figs, 7 refs

Key Words: Transducers, Disks, Vibration measurement

The vertical vibration velocity distributions and frequency spectra of disk-type transducers with bevelled and unbevelled edges are measured as a function of the diameter-to-thickness ratio. In this experiment transducers of $Pb(Zr{\cdot}Ti)O_3$ are used and the diameter-to-thickness ratios are changed from 2 to 12. The frequency spectra are measured in the band from 1-700 kHz, and the velocity distributions are measured along the radial direction with an optical heterodyne technique. The theoretical frequency spectra are analytically derived from the wave equation of the disk-type transducer and compared to the experimental results.

83-1882

The Development of a Four-Component Dynamometer (Entwicklung einer Vier-Komponentenkraftmessanlage)

Q. Suleiman

Industrie Anzeiger, 105 (30), p 55 (Apr 15, 1983) (In German)

Key Words: Measuring instruments

A four-component dynamometer is developed which enables to measure forces F_x, F_y and F_z; e.g., the torque M_d in the plane x-z. The instrument can be expanded to a six-component dynamometer which then can measure the torques $M_d(x\text{-}y)$ and $M_d(z\text{-}y)$. The advantages of the instrument are its price, at about 30% of a piezoelectric pickup, its simple mounting, and its simple amplification and data processing.

83-1883

The Digital Approach to Engineering Measurement - Part II

P. Coldwill and M. Caudell

Data Labs. Ltd., Chartered Mech. Engr., 30 (4), pp 28-34 (Apr 1983) 9 figs

Key Words: Recording instruments, Measuring instruments, Digital techniques, Computer-aided techniques

The first part of this article described the functions of the transient waveform recorder and indicated that the addition of an IEEE-488 interface makes possible its inclusion in computer-based measurement systems. In this second part, it is hoped to remove the mystique attached to the digital recording of signals and the role of the computer in mechanical engineering measurement.

83-1884

Automation of the Measurement System for Research Model Methods of Mechanical System Vibrations

P. Prochazka

Inst. of Thermomechanics, Prague, Czechoslovakia, Strojnícky Časopis, 34 (1-2), pp 167-173 (1983) 3 figs, 5 refs
(In Czech)

Key Words: Vibration measurement, Measuring instruments

The article deals with the instrumentation for model methods of research of vibrations in mechanical systems. The contemporary experimental set-up and conditions of its automation are presented. The design and properties of the digitally programmable sine-wave low-frequency generator are described. The device enables to close the feedback of the measurement system and to control parameters of exciting signals in dependence on characteristics of signal response.

83-1885
Vibration Measurements - Principles and Practice as Applied to General Electric Heavy Duty Gas Turbines
J.D. McHugh
General Electric Co., Schenectady, NY, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 105-116, 17 figs, 13 refs

Key Words: Vibration measurement, Measuring instruments, Turbines, Gas turbines

The selection of a vibration measurement system depends upon definition of objectives together with evaluation of competing approaches and sensors for achieving them. General Electric heavy duty gas turbines use casing-mounted seismic probes as the standard system. The rationale for this selection is discussed, together with the relative merits of alternative approaches.

DYNAMIC TESTS

83-1886
Aircraft Equipment Random Vibration Test Criteria Based on Vibrations Induced by Turbulent Airflow Across Aircraft External Surfaces
J.F. Dreher
Air Force Flight Dynamics Lab., Wright-Patterson AFB, OH, 13 pp (1983)
AD-A123 281

Key Words: Vibration tests, Random vibration, Aircraft equipment, Fluid-induced excitation

Vibrations within jet aircraft are caused by a number of phenomena. The principal sources generally are jet engine noise and turbulent airflow (pseudo-noise) which impinge on aircraft external surfaces; gust, landing, and takeoff loads; and on-board mechanical equipment such as engines and pumps. This paper describes the structural vibrations induced by turbulent airflow and generalizes the findings to develop pertinent, adaptable random vibration test criteria for aircraft equipment.

DIAGNOSTICS

(Also see Nos. 1903, 1926)

83-1887
Some Programmable Calculator Programs Useful in Signature Analysis
J.C. Morehead, III
Miller Printing Equipment Corp., Pittsburgh, PA, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 53-60, 1 table, 4 refs

Key Words: Signature analysis, Computer programs

Programmable calculators are in common use and can be used to evaluate a series of frequencies for comparison with a vibration signature. In this case examples of typical programs that have been written for the HP-41C calculator and 82143A printer are discussed. These programs include gear frequencies, bearing frequencies, sum and difference frequencies, and velocity. The frequency calculation programs evaluate most of the different frequencies that can be generated, but all of these are not generally observed in a vibration signature.

83-1888
Comparative Phase Measurements Aid Vibration Analysis
R.L. Fox
IRD Mechanalysis, Inc., Houston, TX, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 117-122, 3 figs,

Key Words: Diagnostic techniques, Signature analysis, Phase method

Experience has shown that several different mechanical problems can result in very similar vibration amplitude and frequency characteristics and, thus, amplitude-versus-frequency data may not always be sufficient information to make a positive diagnosis. For example, distortion, looseness, structural weakness, reciprocating forces, eccentricity, resonance and other problems can cause vibration often mistaken as simple mass unbalance. Similarly, unbalance of overhung rotors, bent shafts and other problems are often wrongly diagnosed as coupling misalignment. In addition to the required tri-axial amplitude-versus-frequency signatures, determining the relative motion between the various components of the machine and/or supporting structure through comparative phase measurements has been found to be an effective aid in accurately diagnosing specific problems.

83-1889

The Use of Ultrasonic Diagnostic Techniques to Detect Rolling Element Bearing Effects

J.B. Catlin, Jr.

IRD Mechanalysis, Inc., Columbus, OH 43229, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 123-130

Key Words: Diagnostic techniques, Bearings, Rolling contact bearings

Rolling-element bearing defects can be detected by a number of techniques ranging from very simple non-electronic means to sophisticated computer based systems. The use of ultrasonic diagnostics is one technique which has been found to be particularly effective. This paper discusses the mechanisms which cause ultra-sonic signals in defective bearings, and the parameters which affect the characteristics of these signals. This information, in turn, is used to show, from a practical standpoint, how different detection systems operate, and what this means in terms of capability to detect different types of bearing defects.

83-1890

Troubleshooting Vertical Pumps Utilizing Vibration Techniques

D.E. Starr

Vibratronics, Inc., Warren, MI, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 131-133

Key Words: Diagnostic techniques, Pumps

This paper contains procedures for analyzing vertical pumps utilizing vibration techniques. The text is based on field analysis successes covering over fifteen years.

83-1891

Automated Diagnostic System for Engine Maintenance

F. Fanuele and R.A. Rio

Mechanical Technology Inc., Latham, NY, ASME Paper No. 83-GT-103

Key Words: Diagnostic techniques, Aircraft engines, Jet engines

An automated vibration diagnostic system (AVID) developed for the U.S. Air Force jet engine overhaul centers is described. The AVID concept is to automate troubleshooting procedures for fully assembled gas turbine engines. The system extracts high-frequency vibration data from existing, standard instrumentation to provide input to a specialized symptom/fault matrix.

83-1892

Detection of Mechanical Faults in Rotary Blowers

R.W. Jacobs

Monsanto Co., Addyston, OH, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 31-37, 12 figs, 3 refs

Key Words: Diagnostic techniques, Failure detection, Blowers

This paper describes a program which was implemented to reduce the frequency and repair cost of rotary blowers. The construction and operation of rotary blowers is described. A program of failure analysis and resulting preventative maintenance is described. Several modes of mechanical failure for rotary blowers is discussed, and a program to detect and correct mechanical faults in their early stages is described. Four case histories are presented including a set of data taken on a test stand at different speeds and discharge pressures.

83-1893

Methodology for Optimization of Diagnostic Parameters (Methodik zur Optimierung von Diagnoseparametern)

U. Regel
Technische Hochschule Karl-Marx-Stadt, Sektion Technologie der metallverarbeitenden Industrie, German Dem. Rep., Fertigungstechnik und Betrieb, 33 (4), pp 238-240 (1983) 5 figs, 5 refs
(In German)

Key Words: Diagnostic techniques, Optimization

A method for the development and optimization of diagnostic parameters is presented. After evaluating the diagnosis, the individual steps of a widely applicable diagnostic model are described.

83-1894

Machinery Diagnostics and Your FFT

R.L. Eshleman
The Vibration Institute, Clarendon Hills, IL, S/V, Sound Vib., 17 (4), pp 12-18 (Apr 1983) 19 figs, 2 tables, 10 refs

Key Words: Diagnostic techniques, Spectrum analyzers, Fast Fourier transform, Frequency domain method, Time domain method

Many new capabilities are available in machinery diagnostics with the new class of Fast Fourier Transform (FFT) spectrum analyzers. The new microprocessor-based instruments not only provide a frequency domain analysis with resolution of frequencies to narrow bands but also provide a digitized time-domain record which allows another dimension of analysis.

83-1895

Case History of a Steam Turbine Rotordynamic Problem: Theoretical Versus Experimental Results

N.S. Nathoo and O.E. Crenwelge
Shell Development Co., Houston, TX, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 81-89, 8 figs, 1 table, 4 refs

Key Words: Diagnostic techniques, Turbines, Steam turbines, Fans

The theoretical and experimental results of an approach that was used to investigate and correct abnormal vibration characteristics of a steam turbine-fan system are compared. Extensive experiments were conducted to establish the nature of the vibration excursions and to determine their probable causes. As a result, three different problem areas were identified. The turbine rotor-bearing and steam-seal systems were isolated as the major components that should be modified to correct the abnormal response.

83-1896

Shaft Runout under Eddy Current Non-Contact Probes

W.R. Campbell
ARAMCO, Saudi Arabia, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 69-74, 8 figs, 2 refs

Key Words: Diagnostic techniques, Proximity probes, Measurement techniques, Shaft runout, Shafts

This paper describes the problems of shaft runout under an eddy current non-contact displacement probe. It discusses various causes of runout, method of measurement, removal of runout from the shaft at the probe area and some typical case experiences.

83-1897

Induction Motor Magnetic Vibration

J.H. Maxwell
Arizona Public Service Co., Palo Verde Nuclear Generating Station, Phoenix, AZ 85036, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 39-51, 9 figs, 2 tables, 5 refs

Key Words: Diagnostic techniques, Induction motors

This paper concerns the mechanical and magnetic vibrations of 2-pole induction motors. Fundamental physical behavior of the motors are given along with diagnostic techniques and case histories.

83-1898

Computer Simulation of Modern Instrumentation

J.L. Frarey
Shaker Res. Corp., Latham, NY, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 61-67, 10 figs, 2 tables, 1 ref

Key Words: Vibration analyzers, Diagnostic instrumentation, Computerized simulation

The requirements for data gathering, transferring, and processing in order for a computer to simulate modern analysis instrumentation are discussed. A sample simulation is presented for the tracking filter. Multichannel data input, as well as the problems encountered in interfacing digitizing hardware with a computer, are discussed.

83-1899

An Algorithm of Fault Diagnosis for Turbine Generator Operations

J.A. Kubiak, A. Rothhirsch L., and J. Aguirre R.
Instituto de Investigaciones Electricas, Cuernavaca, Mexico, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 91-100, 7 figs, 7 refs

Key Words: Diagnostic techniques, Turbines, Generators, Algorithms

Three algorithms are presented for the identification of faults and their primary causes in the running of turbine generators. They are based on the association of typical faults to their corresponding vibration patterns; i.e., amplitude, frequency, phase angle and wave form. A method of elimination is used in order to single out an actual fault from a group of postulated faults corresponding to the vibration pattern observed. Two algorithms are fed with vibration data acquired either during idle running or when the machine is under load; they are designed to be handled by a micro or minicomputer. A third algorithm indicates the primary causes of the identified faults.

BALANCING

83-1900

In Situ Balancing of Flexible Rotors Using Influence Coefficient Balancing and the Unified Balancing Approach

M.S. Darlow
Rensselaer Polytechnic Inst., Troy, NY, ASME Paper No. 83-GT-178

Key Words: Balancing techniques, Rotors, Flexible rotors, Influence coefficient method, Unified balancing approach

This paper describes a completely portable, microcomputer-based flexible rotor balancing system that uses influence coefficient balancing and the unified balancing approach – two systematic methods that have been shown to be very effective for balancing flexible rotors. The results of a series of verification tests are also presented.

83-1901

Experimental Determination of the "Static" and "Couple" Unbalances in Rotating Systems

S. LaMalfa and J.L. Pombo
Inst. of Appl. Mechanics, Puerto Belgrano Naval Base, 8111 - Argentina, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 101-103, 4 figs, 4 tables, 1 ref

Key Words: Balancing techniques, Multiplane balancing technique, Rotors, Flexible rotors

An experimental static-couple balancing technique which is particularly useful when performing slow speed balancing of large flexible rotors is described. Static and couple unbalances are determined separately using a special circuit.

83-1902

High Speed Rotating Machinery Unbalance, Coupling or Rotor

A.F. Winkler
Dresser Clark Division, Dresser Industries, Inc., Olean, NY 14760, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 75-80, 4 figs, 1 ref

Key Words: Rotors, Couplings, Turbomachinery, Unbalanced mass response

A useable technique to determine the presence and amount of rotor and/or coupling unbalance in a turbo machine is presented. The information gained from this process will help in making the decision to rebalance the rotor, the

coupling, or both. Use of this method requires the rotor and coupling in question to be either keyless hydraulic fit or double keyed shaft end.

MONITORING

83-1903

A State-of-the-Art Monitoring and Diagnostic Program for Main Steam Turbines in Commercial Power Plants

R.G. Canada, R.H. Greene, and P.J. Craig

Technology for Energy Corp., P.O. Box 22966, Knoxville, TN 37922, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 207-213, 8 figs, 1 table

Key Words: Turbines, Steam turbines, Monitoring techniques, Diagnostic techniques

This paper describes an advanced turbine-generator monitoring and diagnostic program being offered to utilities. The objective of this program is to improve turbine-generator availability by using state-of-the-art vibration diagnostic techniques which provide for early detection of developing abnormalities. The program utilizes a transportable, self-contained, vibration laboratory that is built around a computer-based data acquisition and analysis system. This mobile diagnostic center (MDC) will visit various plant sites to perform periodic diagnostic tests on turbine-generators or other types of rotating machinery, such as pumps and compressors. An overview of the monitoring and diagnostic program is presented along with a brief discussion of a turbine-generator case history that had an impact on the design of the MDC system features.

83-1904

Hydraulic Coupling Failures and Their Vibration Response - A Case History

T.E. Helmer

Georgia Pacific Co., Plaquemine, LA, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 177-179, 4 figs

Key Words: Couplings, Hydraulic couplings, Diagnostic techniques, Case histories

The application of hydraulic fit coupling hubs to high speed centrifugal machinery has presented a potential maintenance problem that can lead to catastrophic failure of the driver and driven equipment in a matter of seconds. This paper includes discussion of hydraulic fit hub installation, the pitfalls encountered, and the failure mechanism that leads to catastrophic damage. Recognition of machinery vibration response, caused by this type of failure, is presented in a case history.

83-1905

Correlation of the Acoustic Emission Signal Characteristics with the Fracture Processes

Z. Převorovský

Inst. of Thermomechanics, Czechoslovak Academy of Sciences, Prague, Czechoslovakia, Strojnícky Časopis, 34 (1-2), pp 231-244 (1983) 8 figs, 8 refs
(In Czech)

Key Words: Monitoring techniques, Acoustic emission, Crack propagation

Experimental investigation of slow crack propagation in glassy amorphous polymers is presented. During a fracture test on the side-grooved DCB cleavage specimens, the acoustic emission signals are monitored using a minicomputer-based automatic measurement system with the DUNEGAN/ENDEVCO AE analyzer. The instantaneous crack length, stress intensity factor, crack velocity and other fracture characteristics are then evaluated and related to the AE signal parameters.

83-1906

Acoustic Emission (Emissione Acustica)

F. Tonolini

Centro Informazioni Studi Esperienze, Milan, Italy, Rept. No. CISE-1797, 10 pp (1982) (Presented at Corso di Aggiornamento Sulle Tech. Di Esame Non Distruttivo, Turin, Apr 21, 1982)
N83-14509
(In Italian)

Key Words: Monitoring techniques, Acoustic emission, Nondestructive tests

Acoustic emission nondestructive test procedures, the equipment to implement the techniques, and the applications of these tests to monitoring and control are described. The acoustic emissions produced by fluid leaks, microstructural events, friction, shock and other sources are examined. The

instrumentation includes a minicomputer for real time data processing. The main result of the analysis is source localization.

83-1907

Gear Drives -- Temperature, Noise, and Vibration

D.N. Timmermann

The Falk Corp., Subsidiary of Sundstrand Corp., Milwaukee, WI 53201, Tappi J., 66 (4), pp 70-73 (Apr 1983) 4 figs, 3 refs

Key Words: Monitoring techniques, Gear drives

Temperature, noise, and vibration are useful measurements to determine the health of the gear reducer. This paper deals with enclosed drives employing helical gears and rolling element bearings in a size range from 5 to 1000 hp at 1750 rpm input. It assumes that the function of mechanical maintenance is to keep equipment running and not just to repair it. The following areas are considered: what levels of temperature, noise, and vibration can be expected before the gear drive is purchased; why take field measurements to establish a pedigree for your equipment; what elements within your control can alter expected performance; and what to do in the event of a change.

83-1908

A Decade of Experience with Plant-Wide Acoustic IFD Systems

B.C. Baird and H.P. Bloch

IFD Technology Co., Houston, TX, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 135-143, 8 figs, 1 table, 13 refs

Key Words: Monitoring techniques, Incipient failure detection

This paper summarizes the design philosophy, implementation phases and experience of plant-wide, computerized acoustic incipient failure (IFD) systems at chemical plants in Baytown, Texas. Ten years after demonstrating the viability of IFD for condition monitoring of pumps, extruders, gears, electric motors, etc., the results of years of utilizing two generations of large-scale systems in petrochemical plant environments with their unique operating and maintenance philosophies are critically examined. Early benefit-to-cost projections are re-analyzed in light of these observations and preferences voiced for the configuration of future possible condition monitoring systems for general purpose machinery.

83-1909

A Review of Rolling Element Bearing Health Monitoring

P.Y. Kim and I.R.G. Lowe

Natl. Res. Council Canada, Ottawa, Ontario, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 145-154, 57 refs

Key Words: Monitoring techniques, Rolling contact bearings, Bearings, Freight cars, Railroad cars

State-of-the-art health monitoring methods for rolling element bearings are reviewed with particular reference to railway freight cars. The paper reviews two aspects: health monitoring by various types of vibration measurements and by wear debris analysis of the lubricant. Instrumentation available is briefly surveyed.

83-1910

Typical Vibration Signatures – Case Studies

M.W. Buehler and C.D. Bertin

Amoco Oil Co., Whiting, IN, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 191-206, 24 figs

Key Words: Vibration signatures, Signature analysis, Monitoring techniques, Rotating machinery, Case histories

Over the last several years the use of vibration analysis has become a significant tool in the diagnosis of rotating equipment conditions through machinery health monitoring. This approach has saved hundreds of thousands of dollars through the prevention of catastrophic failure, diagnosis of equipment problems which allows a shorter downtime, and solving a problem without extensive unnecessary repairs to the equipment. Some standard or typical vibration signatures have been collected over the last several years that are classic symptoms of different problems that can occur in rotating equipment. Several examples of these typical vibration signatures have been collected and put together in a form to be used as a training tool for maintenance engineers and other personnel.

83-1911

Vibration Signature Analysis at the Eddystone Plant of Philadelphia Electric

J.W. McElroy

Philadelphia Electric Co., Philadelphia, PA, Machinery Vibration Monitoring and Analysis Mtg., Proc., Houston, TX, Apr 19-21, 1983. Spons. Vibration Institute, Clarendon Hills, IL, pp 215-224, 8 figs, 2 tables, 3 refs

Key Words: Monitoring techniques, Signature analysis, Vibration signatures, Incipient failure detection, Power plants (facilities)

The need for improved availability of large fossil-fueled power plants results from the foreseen future reduction in reserve margins of installed capacity and the trend in plant equivalent availability, which has decreased 15% over the ten-year period 1968-77. Forced outage of plant rotating equipment is seen to be a prime contributor to this loss in availability. Efforts using vibration signature analysis (VSA) techniques have been directed towards the prediction of incipient failure in a number of fossil-fuel plants, notably a two-year monitoring effort under EPRI sponsorship. It is now believed that the technology has advanced to the point where a complete predictive maintenance package based on vibration signatures can be developed. Therefore, the goal of this EPRI project is to carry the state of the art into utility maintenance planning procedures by qualifying a total on-line monitoring and diagnostic system for utility use.

83-1912

A Noncontacting Measurement Technique for a Continuous Monitoring of Screw Connections (Ein beruhrungsloses Messverfahren zur kontinuierlichen Uberwachung von Schraubenverbindungen)

J. Kolitsch

Munich, Germany, VDI-Z, 125 (3), pp 61-66 (Feb 1983) 8 figs, 1 table, 4 refs

(In German)

Key Words: Monitoring techniques, Proximity probes, Screws, Loosening

The instrument consists of an inductive proximity probe for detecting the characteristic signature of the monitored screw with reference to a hexagonal nut, and an analog data processor which evaluates the signals and gives off a warning signal. The measurement technique is evaluated by a mathematical model which links the signal to be evaluted; i.e., an inductive electric current, with an angle indicating the instantaneous location of the screw head. Such a linkage enables to detect the loose rotation of an individual screw from the signature. The technique has been successfully applied by an automobile manufacturer for the evaluation of screw looseness of spur bevel gear screws of motor vehicle differential gears and it is also generally applicable for the monitoring of screws of rotating machinery components.

ANALYSIS AND DESIGN

ANALYTICAL METHODS

83-1913

Lower Bounds to Large Displacements of Impulsively Loaded Plastically Orthotropic Structures

V.V. The and A. Sawczuk

Inst. of Mechanics, Natl. Ctr. for Scientific Res., Hanoi, Vietnam, Intl. J. Solids Struc., 19 (3), pp 189-205 (1983) 7 figs, 2 tables, 26 refs

Key Words: Boundary value problems, Impulse response, Plastic properties

Impulsively loaded plastic structures deform beyond the limits of applicability of the geometrically linear theory. It was experimentally observed that due to the membrane action actual permanent displacements are smaller than those predicted by the infinitesimal theory. The paper advances a technique allowing to bound from below the permanent, moderately large deflection at a chosen point of a rigid-plastic, dynamically loaded structure. The method originally developed for isotropic solids and introducing an auxiliary kinematically admissible velocity field allowing to estimate the dissipation due to the nonlinear terms in the strain rates is extended to orthotropic plates and shells.

83-1914

Dynamic Analysis of Three Dimensional Constrained Mechanical Systems Using Euler Parameters

I.-S. Chung, C.-O. Chang, E.J. Haug, R.A. Wehage, and R.R. Beck

College of Engrg., Univ. of Iowa, Iowa City, IA, Rept. No. U. of IOWA-81-11, TACOM-TR-12591, 158 pp (Oct 1981)

AD-A124 100

Key Words: Equations of motion, Mechanical systems, Dynamic structural analysis

This paper presents a computer-based method for formulation and efficient solution of nonlinear, constrained differential equations of motion for spatial dynamic analysis of mechanical systems. Nonlinear holonomic constraint equations and differential equations of motion are written in terms of a maximal set of Cartesian generalized coordinates, three translational and four rotational coordinates for each rigid body in the system, where the rotational coordinates are the Euler parameters.

83-1915

A General Approach to the Dynamic Analysis of Elastic Mechanism Systems

D.A. Turcic

Ph.D. Thesis, The Pennsylvania State Univ., 226 pp (1982)
DA8305708

Key Words: Finite element technique, Equations of motion, Four bar mechanisms, Computer programs

This dissertation deals with the development of a general approach to the formulation and solution of the equations of motion for a complex elastic mechanism system. The equations of motion are derived by utilizing a finite element approximation. The derivation and final form of the equations of motion provide the capability to model a general two- or three-dimensional complex elastic mechanism, to include the nonlinear rigid-body and elastic motion coupling terms in a general representation, and to allow any finite element type to be utilized in the model. The primary method for the solution of the equations of motion is a steady-state solution method that allows the steady-state solution to be calculated without costly integration over many cycles. A computer program is designed and written to implement the modeling and solution techniques. Results of an experimental investigation of an elastic four-bar linkage are also presented.

83-1916

Fast Response Method for Undamped Structures

Y.T. Leung
Dept. of Civil Engrg., Univ. of Hong Kong, Hong Kong, Engrg. Struc., 5 (2), pp 141-149 (Apr 1983) 1 fig, 13 tables, 6 refs

Key Words: Undamped structures, Harmonic response

The conventional modal method in structural response analysis converges very slowly with respect to the number of natural modes. The convergent property is improved by using the condensed stiffness and mass matrices of the system. Thus, less natural modes are required and the difficulties of computing high natural modes are avoided. Undamped response due to deterministic and random excitations are discussed and numerical examples are given.

83-1917

Linearization of Non-Linear Stochastically Excited Dynamic Systems

M. Apetaur and F. Opička
Technical Univ. of Prague, Prague 6, Czechoslovakia,
J. Sound Vib., 86 (4), pp 563-585 (Feb 22, 1983) 26 figs, 4 tables, 5 refs

Key Words: Linearization methods, Random excitation, Stiffness coefficients, Damping coefficients

A second order linearization method for nonlinear stochastically excited dynamic systems is described. Second order probabilistic functions are used to evaluate the linearized stiffness or damping coefficients of the nonlinear elements. The values of these coefficients are frequency dependent. Principles of both first order and second order methods are discussed.

83-1918

An Analytical Model of Two-Dimensional Impact/Sliding Response to Harmonic Excitation

G.S. Whiston
Central Electricity Res. Labs., Kelvin Ave., Leatherhead KT22 7SE, UK, J. Sound Vib., 86 (4), pp 557-562 (Feb 22, 1983) 2 figs, 5 refs

Key Words: Wear, Harmonic excitation, Vibration excitation

An analytical method for the generation of periodic solutions for impact/sliding response to harmonic excitation of a two-dimensional linear oscillator is outlined and applied to generate a simple symmetric solution. The method yields impact reaction forces and sliding distances and hence enables wear rate calculations to be performed.

MODELING TECHNIQUES

83-1919

Dynamic Modeling of Structures from Measured Complex Modes

S.R. Ibrahim

Old Dominion Univ., Norfolk, VA, AIAA J., 21 (6), pp 898-901 (June 1983) 1 fig, 2 tables, 13 refs

Key Words: Mathematical models, Mass matrices, Damping coefficients, Stiffness coefficients

A technique is presented to use a set of identified complex modes together with an analytical mathematical model of a structure under test to compute improved mass, stiffness, and damping matrices. A set of identified normal modes, computed from the measured complex modes, is used in the mass orthogonality equation to compute an improved mass matrix. This eliminates possible errors that may result from using approximated complex modes as normal modes. The improved mass matrix, the measured complex modes, and the higher analytical modes are then used to compute the improved stiffness and damping matrices.

83-1920

Distorting Effects Due to Modelling Impact Phenomena in Continuum by Finite Element Method

M. Okrouhlík and R. Brepta

Inst. of Thermomechanics, Czechoslovak Academy of Sciences, Prague, Czechoslovakia, Strojnícky Časopis, 34 (1-2), pp 255-265 (1983) 11 figs, 5 refs (In Czech)

Key Words: Mathematical models, Impact response, Finite element technique

Modelling the nonstationary stress wave propagation problems in continuum by the finite element method is always accompanied by certain specific side effects such as the distortion of propagated pulse, oscillations in front of the wavefront, etc. The aim of this paper is to explain these phenomena and to determine the conditions for the safe usage of the finite element method in nonstationary dynamics.

NUMERICAL METHODS

83-1921

Operator Split Methods in the Numerical Solution of the Finite Deformation Elastoplastic Dynamic Problem

P.M. Pinsky, M. Ortiz, and R.L. Taylor

Div. of Engrg., Brown Univ., Providence, RI 02912, Computers Struc., 17 (3), pp 345-359 (1983) 8 figs, 34 refs

Key Words: Numerical methods, Elastic properties, Finite deformation theory

The spatial formulation of the elastoplastic dynamic problem for finite deformations is considered. A thermodynamic argument leads to an additive decomposition of the spatial rate of deformation tensor and allows an operator split of the evolutionary equations of the problem into elastic and plastic parts. This operator split is taken as the basis for the definition of a global product algorithm. In the context of finite element discretization the product algorithm entails, for every time step, the solution of a nonlinear elastodynamic problem followed by the application of plastic algorithms that operate on the stresses and internal variables at the integration points and bring in the plastic constitutive equations. Suitable plastic algorithms are discussed for the cases of perfect and hardening plasticity and viscoplasticity.

OPTIMIZATION TECHNIQUES

(See No. 1798)

DESIGN TECHNIQUES

83-1922

Electronic Housing Design for a Random Vibration Environment

W.D. Thatcher

Government Electronics Group, Motorola, Inc., J. Environ. Sci., 26 (2), pp 29-32 (Mar/Apr 1983) 10 figs, 2 tables, 2 refs

Key Words: Housings, Electronic instrumentation, Random excitation, Design techniques

This paper highlights the activities involved in the design of a 196N (44-pound) receiver with a requirement to survive a 21 gram random vibration environment. The method used to establish design criteria is described and the structural analyses techniques are shown. Design verification test data is presented for both the dynamic test model and the qualification test model.

COMPUTER PROGRAMS

(Also see Nos. 1702, 1806, 1887)

83-1923

Aircraft Noise Prediction Program User's Manual

R.E. Gillian

NASA Langley Res. Ctr., Hampton, VA, Rept. No. NASA-TM-84486, 323 pp (1982)
N83-16150

Key Words: Computer programs, Aircraft noise, Noise prediction

The aircraft noise prediction program (ANOPP) predicts aircraft noise with the best methods available. This manual is designed to give the user an understanding of the capabilities of ANOPP and to show how to formulate problems and obtain solutions by using these capabilities.

83-1924

FAA Integrated Noise Model Validation: Analysis of Air Carrier Flyovers at Seattle-Tacoma Airport

G.W. Flathers, II

METRIK Div., MITRE Corp., McLean, VA, Rept. No. MTR-82W162, FAA/EE-82-19, 73 pp (Nov 1982)
AD-A124 097

Key Words: Computer programs, Aircraft noise, Airports

The Federal Aviation Administration's Integrated Noise Model (INM) is a series of computer programs designed to estimate environmental noise levels in the vicinity of an airport. As part of the effors to validate INM outputs for the FAA, comparisons were made between the Sound Exposure Levels (SEL) of actual aircraft flyovers at Seattle-Tacoma International Airport and SELs which were computed by the INM for identical conditions. Data for this analysis were obtained from the FAA ARTS-III radar to determine the actual slant range and velocity of observed aircraft, and from noise monitors located beyond each runway end to determine actual SEL values associated with observed aircraft. The report presents the results of the comparison of INM and observed SEL values for seven transport-category aircraft.

83-1925

Comparison of HULL Hydrocode Computations of Shock Tube Blockage Effects on Target Loading for Step Shocks and Rapidly-Decaying Shocks

J.D. Wortman and R.E. Lottero

Ballistic Res. Lab., Army Armament Res. and Dev. Command, Aberdeen Proving Ground, MD, Rept. No. ARBRL-MR-03232, 52 pp (Dec 1982)
AD-A123 274

Key Words: Computer programs, Shock wave propagation

The HULL hydrocode was used to make two-dimensional calculations (for the three-dimensional axisymmetric problem) of a rapidly-decaying shock wave striking a finite right-circular cylinder whose axis was coincident with that of a cylindrical shock tube. Calculations were made for three peak shock over-pressures for 20 percent blockage and for a free-field encounter. These results were then compared with previously reported HULL computations for comparable overpressure step shocks for the same configuration.

GENERAL TOPICS

BIBLIOGRAPHIES

83-1926

Nondestructive Testing of Joints. 1972 - February, 1983 (Citations from the International Aerospace Abstracts Data Base)

NTIS, Springfield, VA, Rept. for 1972 - Feb 1983, 134 pp (Feb 1983)
PB83-860338

Key Words: Joints (junctions), Nondestructive tests, Diagnostic techniques, Bibliographies

This bibliography contains 136 citations concerning techniques and technology for the nondestructive testing or evaluation of joints (bonded, brazed, blued, soldered, etc.) for the detection of flaws or defects which may affect their properties and behavior. Attention is also given to evaluations of the strength of various types of joints.

83-1927

Nondestructive Acoustic Emission Testing of Nuclear Reactor Components. 1966 - February, 1983 (Citations from the Metals Abstracts Data Base)

NTIS, Springfield, VA, 74 pp (Feb 1983)
PB83-860668

Key Words: Acoustic emission, Nuclear reactor components, Nondestructive tests, Bibliographies

This retrospective bibliography contains 94 citations concerning nondestructive inspection and evaluation of nuclear reactor components, especially pressure vessels, by acoustic emission techniques and equipment for the detection of flaws or structural defects.

83-1928

Non-Ultrasonic Acoustic Nondestructive Testing. 1975 - February, 1983 (Citations from the International Information Service for the Physics and Engineering Communities Data Base)

NTIS, Springfield, VA, 178 pp (Feb 1983)
PB83-860429

Key Words: Nondestructive tests, Acoustic tests, Ultrasonic techniques, Bibliographies

This bibliography contains 157 citations concerning non-ultrasonic, acoustic nondestructive inspection and evaluation techniques, equipment, and applications. Topics include acoustic emission techniques, acoustic holography, and acoustic microscopy. Applications for a variety of materials, objects, and structures are presented.

USEFUL APPLICATIONS

83-1929

Pneumatic Vibration for Stress Screening

D.E. Vollrath and R.A. Buck

Rockwell International, Cedar Rapids, IA, J. Environ. Sci., 26 (2), pp 50-53 (Mar/Apr 1983) 4 figs, 2 tables, 5 refs

Key Words: Screening, Vibratory techniques

The introduction of pneumatic triaxial vibration equipment at Rockwell International for environmental stress screening is described. The discussion covers the initial justification, cost savings, test levels and duration, noise level measurements, calibration techniques, production, and personnel education problems.

AUTHOR INDEX

TECHNICAL NOTES

J.S. Burdess
The Control of Linear Multivariable Systems in the Presence of Harmonic Disturbances
J. Dynam. Syst., Meas. Control, Trans. ASME, 105 (1), pp 48-49 (Mar 1983) 1 fig, 3 refs

S.R. Reid and S.R. Hendry
Dynamic Response of a Pulse-Loaded Ring Immersed in an Acoustic Medium
J. Appl. Mech., Trans. ASME, 50 (1), pp 224-225 (Mar 1983) 3 figs, 4 refs

L. Schwarmann
On Improving the Fatigue Performance of a Double-Shear Lap Joint
Intl. J. Fatigue, 5 (2), pp 105-111 (Apr 1983) 11 figs, 2 tables, 8 refs

R. Schmidt
Technique for Estimating Natural Frequencies
ASCE J. Engrg. Mech., 109 (2), pp 654-657 (Apr 1983) 4 refs

N. Ganesan and M.S. Dhotarad
Vibration Analysis of Mindlin Plates
J. Sound Vib., 87 (4), pp 643-645 (Apr 22, 1983) 1 table, 9 refs

S.A.L. Glegg
Sound Radiation from Beams at Low Frequencies
J. Sound Vib., 87 (4), pp 637-642 (Apr 22, 1983) 1 fig, 2 tables, 8 refs

D.D. Adams and W.L. Wood
Comparison of Hilber-Hughes-Taylor and Bossak 'a-M[illegible]' for the Numerical Integration of Vibration Equations
Intl. J. Numer. Methods Engrg., 19 (5), pp 765-771 (May 1983) 8 figs, 3 refs

R.Y. Tam and M.S. Cramer
The Effects of Finite Amplitude on the Behavior of Antisymmetric Waves on Two-Dimensional Liquid Sheets
J. Appl. Mech., Trans. ASME, 50 (2), pp 459-460 (June 1983) 12 refs

M. Chandra and R. Sinhasan
On the Dynamic Behavior of Two Gas-Lubricated Two-Lobe Journal Bearing Configurations
ASLE, Trans., 26 (3), pp 411-414 (July 1983) 1 fig, 1 table, 8 refs

CALENDAR

OCTOBER 1983

3-7 SAE Aerospace Congress and Exposition [SAE] Long Beach, CA *(SAE Hqs.)*

4 Advances in Dynamic Analysis and Testing [SAE Technical Committee G-5] SAE Aerospace Congress and Exposition, Long Beach, CA *(Roy W. Mustain, Rockwell Space Transportation and Systems Group, Mail Sta. AB97, 12214 Lakewood Blvd., Downey, CA 90241)*

17-19 Stapp Car Crash Conference [SAE] San Diego, CA *(SAE Hqs.)*

17-20 Lubrication Conference [ASME] Hartford, CA *(ASME Hqs.)*

18-20 54th Shock and Vibration Symposium [Shock and Vibration Information Center, Washington, DC] Pasadena, CA *(SVIC, Naval Research Lab., Code 5804, Washington, DC 20375)*

31-Nov 4 John C. Snowdon Vibration Control Seminar [Applied Research Lab., Pennsylvania State Univ.] University Park, PA *(Mary Ann Solic, 410 Keller Conference Center, University Park, PA 16802 - (814) 865-4591)*

NOVEMBER 1983

7-10 Truck and Bus Meeting and Exposition [SAE] Cleveland, OH *(SAE Hqs.)*

7-11 Acoustical Society of America, Fall Meeting [ASA] San Diego, CA *(ASA Hqs.)*

13-18 American Society of Mechanical Engineers, Winter Annual Meeting [ASME] Boston, MA *(ASME Hqs.)*

15-17 12th Turbomachinery Symposium [Turbomachinery Labs.] Houston, TX *(Dr. Peter E. Jenkins, Turbomachinery Laboratories, Dept. of Mechanical Engineering, Texas A&M University, College Station, TX 77843)*

FEBRUARY 1984

27-Mar 2 International Congress and Exposition [SAE] Detroit, MI *(SAE Hqs.)*

27-29 IAVD Congress on Vehicle and Component Design [IAVD] Geneva, Switzerland *(Dr. M.A. Dorgham, International Association for Vehicle Design, The Open University, Walton Hall, Milton Keynes MK7 6AA - (0908) 653945.*

MARCH 1984

13-15 12th Symposium on Explosives and Pyrotechnics [Applied Physics Lab. of Franklin Research Center] San Diego, CA *(E&P Affairs, Franklin Research Center, Philadelphia, PA 19103 - (215) 448-1236)*

20-23 Balancing of Rotating Machinery Symposium [Vibration Institute] Philadelphia, Pennsylvania *(Dr. Ronald L. Eshleman, Director, The Vibration Institute, 101 W. 55th St., Suite 206, Clarendon Hills, IL 60514 - (312) 654-2254)*

APRIL 1984

9-12 Design Engineering Conference and Show [ASME] Chicago, IL *(ASME Hqs.)*

9-13 2nd International Conference on Recent Advances in Structural Dynamics [Institute of Sound and Vibration Research] Southampton, England *(Dr. Maurice Petyt, Institute of Sound and Vibration Research, The University of Southampton, S09 5NH, England - (0703) 559122, ext. 2297)*

30-May 3 Institute of Environmental Sciences' 30th Annual Technical Meeting [IES] Orlando, Florida *(IES, 940 E. Northwest Hwy., Mt. Prospect, IL 60056 - (312) 255-1561)*

MAY 1984

7-11 Acoustical Society of America, Spring Meeting [ASA] Norfolk, VA *(ASA Hqs.)*

10-11 12th Southeastern Conference on Theoretical and Applied Mechanics [Auburn University] Callaway Gardens, Pine Mountain, GA *(J. Fred O'Brien, Director, Engineering Extension Service, Auburn University, AL 36849 - (205) 826-4370)*

JULY 1984

21-28 8th World Conference on Earthquake Engineering [Earthquake Engineering Research Institute] San Francisco, CA *(EERI-8WCEE, 2620 Telegraph Avenue, Berkeley, CA 94704)*

AUGUST 1984

6-9 West Coast International Meeting [SAE] San Diego, CA *(SAE Hqs.)*

CALENDAR ACRONYM DEFINITIONS AND ADDRESSES OF SOCIETY HEADQUARTERS

AHS: American Helicopter Society
1325 18 St. N.W.
Washington, D.C. 20036

AIAA: American Institute of Aeronautics and Astronautics
1290 Sixth Ave.
New York, NY 10019

ASA: Acoustical Society of America
335 E. 45th St.
New York, NY 10017

ASCE: American Society of Civil Engineers
345 E. 45th St.
New York, NY 10017

ASME: American Society of Mechanical Engineers
345 E. 45th St.
New York, NY 10017

ASTM: American Society for Testing and Materials
1916 Race St.
Philadelph[illegible] PA 19103

ICF: In[illegible]ional Congress on Fracture
To[illegible]ku University
Sendai, Japan

IEEE: Institute of Electrical and Electronics Engineers
345 E. 47th St.
New York, NY 10017

IES: Institute of Environmental Sciences
940 E. Northwest Highway
Mt. Prospect, IL 60056

IMechE: Institution of Mechanical Engineers
1 Birdcage Walk, Westminster,
London SW1, UK

IFToMM: International Federation for Theory of Machines and Mechanisms
U.S. Council for TMM
c/o Univ. Mass., Dept. ME
Amherst, MA 01002

INCE: Institute of Noise Control Engineering
P.O. Box 3206, Arlington Branch
Poughkeepsie, NY 12603

ISA: Instrument Society of America
400 Stanwix St.
Pittsburgh, PA 15222

SAE: Society of Automotive Engineers
400 Commonwealth Drive
Warrendale, PA 15096

SEE: Society of Environmental Engineers
Owles Hall, Buntingford, Hertz.
SG9 9PL, England

SESA: Society for Experimental Stress Analysis
21 Bridge Sq.
Westport, CT 06880

SNAME: Society of Naval Architects and Marine Engineers
74 Trinity Pl.
New York, NY 10006

SPE: Society of Petroleum Engineers
6200 N. Central Expressway
Dallas, TX 75206

SVIC: Shock and Vibration Information Center
Naval Research Lab., Code 5804
Washington, D.C. 20375

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Volume 15, No. 9 September 1983

EDITORIAL

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ABSTRACTS FROM THE CURRENT LITERATURE.

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